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EPA Superfund
Record of Decision:

COMMENCEMENT BAY, NEAR SHORE/TIDE FLATS
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RECORD OF DECISION

COMMENCEMENT BAY NEARSHORE/
TIDEFLATS SUPERFUND SITE

OPERABLE UNIT 02

ASARCO TACOMA SMELTER FACILITY
RUSTON AND TACOMA, WASHINGTON

March 1995

U.S. Environmental Protection Agency

Region 10

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Ruston and Tacoma, Washington

Statement of Basis and Purpose

This decision document presents the selected remedial action for the former Asarco Tacoma Smelter Facility and adjacent slag peninsula, in Ruston and Tacoma, Washington, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for this site. The State of Washington concurs with the selected remedy.

This Record of Decision (ROD) describes the final cleanup remedy for soil, slag and surface water and disposal of hazardous soils, demolition debris, and residential soils. This ROD is intended to be an interim action for ground water.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent or substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

EPA has divided the Commencement Bay/Nearshore Tideflats Superfund site into seven operable units (OUs) in order to facilitate the investigation, analysis, and cleanup of this very large site. Four of these OUs are associated with the former Asarco smelter:

- OU 02 Asarco Tacoma Smelter and Slag Peninsula
- OU 04 Asarco Off-Property (Ruston/North Tacoma Study Area)
- OU 06 Asarco Sediments
- OU 07 Asarco Demolition

The remedy described in this ROD addresses OU 02 and involves the cleanup of metal (e.g., arsenic, copper, lead) and organic contaminated soil, slag, and surface water and ground water found at the former smelter facility and adjacent slag peninsula. This remedy will address the principal threats posed by conditions at the Site, which are areas that continue to act as the primary known sources (source areas) of contamination to ground water and surface water that are flowing into Commencement Bay. The remedy includes the following elements:

- Excavate source area soils and slag (approximately 160,000 cubic yards).

- Dispose of source area soils and demolition debris designated as hazardous waste (approximately 240,000 cubic yards total) in an on-site containment facility (OCF) that meets or exceeds regulatory standards for hazardous waste landfills.

- Cap the entire Site (plant site soils and slag and the slag peninsula). The low permeability cap will be composed of layers of clean soils, gravel, and clay. The contaminated residential soils excavated from the Ruston/North Tacoma Study Area will be used as a sub-base for the cap.

- Demolish the remaining buildings and structures.

- Replace the entire surface water drainage system.

- Armor portions of the plant site and slag peninsula shoreline.

- Continue to monitor the surface water and ground water.

- Sample marine sediments.

- Develop and implement an enforceable program of restrictions and guidelines to supplement the actual cleanup activities to ensure that the remedial action remains protective and that development activities do not impact the long-term effectiveness of the cleanup.

If it is determined that source control activities do not result in ground water that meets federal and state standards, additional cleanup activities, if practicable, will be identified in a separate ROD.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this Site. However, because treatment of the principal threats of the Site was found not to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element.

At this Site, EPA's determination that soil treatment was not practicable was based on several factors, including the effectiveness of an OCF at isolating contaminated soils and debris from the environment, the community's stated preference during public comment for on-site containment of contaminated waste, and the nearly $30 million difference in cost between treatment and disposal of soil and disposal of soil without treatment in an OCF.

Because the remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted no less often than every five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

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Chuck Clarke Date
Regional Administrator
U.S. EPA Region 10

DECISION SUMMARY

Commencement Bay Nearshore/Tideflats Superfund Site
Asarco Tacoma Smelter Site
Operable Unit 02
Tacoma/Ruston, Washington

1.0 SITE DESCRIPTION

The Asarco Tacoma Smelter Superfund site ("Asarco Site" or "the Site") is an operable unit (OU) of the larger Commencement Bay Nearshore/Tideflats (CB N/T) Superfund site. The CB N/T Superfund site was listed on the interim priority list by the U.S. Environmental Protection Agency (EPA) in 1981, and included in the first published National Priorities List in September 1983. The Site is located on the western shore of Commencement Bay and consists of 67 acres of property owned by Asarco, Inc. and a 23 acre slag peninsula, home of the Tacoma Yacht Club. The Town of Ruston, the City of Tacoma and the Metropolitan Park District are the three municipalities that have zoning and permitting jurisdiction at this Site. This Record of Decision (ROD) addresses contaminated soils, slag, demolition debris, surface water and ground water on the Site.

The general area of the former Asarco Smelter consists of steep slopes extending down to Commencement Bay producing bluffs along portions of the shoreline. Many of the original smelter buildings and structures were constructed on slag fill, which extended the existing shoreline when molten slag from smelting operations was poured into Commencement Bay. A car tunnel and railroad tunnel are located between the stack hill and the arsenic kitchen area. Some dense vegetation exists on steep slopes (for example, the stack hill) and along the bluffs above Commencement Bay, see Figure 1-1.

The adjacent slag peninsula is composed of different forms of slag (molten or granulated) that were poured or placed on many occasions between 1930 and 1970. Its primary surface features are the Tacoma Yacht Club building, a paved access road, and paved parking areas. An estimated 15 million tons of slag exist at the smelter property and slag peninsula. Surface water features on the smelter property include surface water in the cooling pond and south and east stack hill areas and a number of springs and seeps around the stack hill and arsenic kitchen areas. Surface water drains into one of four drain systems and then into outfalls at the Site called the city (owned by the City of Tacoma), north, middle, and south outfalls. The latter three are owned by Asarco.

A complex pattern of ground water flows through or beneath the smelter property, including through the slag, into Commencement Bay. Three primary groundwater aquifers (water bearing zones) have been identified; two relatively shallow aquifers and one deep aquifer. A thick silt barrier exists between the shallow and deep aquifers throughout much of the Site. Because of the high degree of fractures in and porous nature of the slag, the tides bring seawater inland several hundred feet where it mixes with ground water. The ground water within each of the three aquifers is designated as either potential drinking water (Class IIB) or as non-potable water (Class III). No one is currently drinking the ground water at or near the Site.

Prior to 1890, a number of sawmills were active in the area and deposited wood waste along the shoreline. From 1890 through 1912, the property was used as a lead smelter and refinery. Asarco purchased the property in 1905 and converted it in 1912 into a facility to smelt and refine copper from copper bearing ores and concentrates shipped in from other locations. By-products of the smelting operations were further refined to produce other marketable products, such as arsenic, sulfuric acid, liquid sulfur dioxide, and slag. Asarco ended operation of the smelter in 1985.

Metals were released into the soil, air, and Commencement Bay as a result of the smelting and refining operations. Some examples of the metals present at the Site are arsenic, cadmium, copper, lead, and zinc. Metals in slag or released into soil have migrated to surface and ground water at the Site. Ores that were smelted at the Site have left metals in the buildings and structures on the Site.

There are no listed Resource Conservation and Recovery Act (RCRA) wastes at the Site. In several areas, contaminated soils are RCRA characteristic waste because they fail the Toxicity Characteristic leaching Procedure. Slag is not a RCRA waste under the Bevill exemption (40

C.F.R. § 261.4).

There are no known floodplain zones or endangered species at this Site. There are several small areas of the Site, other than the cooling pond, that have been identified as potential wetlands. If these areas are confirmed as wetlands and if remediation occurs in these areas, the extent of mitigation will be determined during remedial design.

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2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 HISTORICAL SITE ACTIVITIES

During the active industrial life of the Asarco Tacoma Smelter, the primary product was refined copper. By-products of the copper smelting process included sulfuric acid, liquid sulfur dioxide, arsenic trioxide, arsenic metal, and copper reverbatory slag. The following is a brief chronological summary of operations at the former Asarco Tacoma smelter.

- 1890 Began operation as a lead smelter under ownership of the Tacoma Smelter Company.
- 1902 Copper production was started.
- 1905 Asarco purchased the smelter.
- 1917 Plant was rebuilt, stack was constructed, electrostatic precipitators were added.
- 1930 Blast furnace smelting operations were discontinued and replaced with reverberatories that produced slag as one by-product.
- 1974 A liquid sulfur dioxide plant began operation, using a dimethylaniline process.
- 1977 A baghouse was installed to handle dust from the arsenic kitchen and metallic arsenic plant.
- 1978 Electrolytic refinery ceased operation.
- 1985 Copper smelting operations were discontinued.
- 1986 Arsenic production was discontinued, and facility was taken completely out of production.

As described above, much of the present facility is built over fill material, including slag, which was placed by Asarco as part of the smelter operations. Since January 1987, Asarco has completed two phases of demolition activities at the Site. Facilities in the stack area associated with copper smelting and the production of both arsenic trioxide and metallic arsenic were demolished in 1987-1988 during Phase I Site Stabilization. The majority of the remaining building and structures, including the smelter stack, were demolished in 1992-1994 during Phase II Site Stabilization. Much of the Site (where these facilities were located) has been leveled and, to a minor extent, graded.

2.2 ENFORCEMENT ACTIVITIES

The history of regulatory activities affecting the former Asarco Tacoma Smelter began in the late 1960s with the passage of air emission standards by the Puget Sound Air Pollution Control Authority (PSAPCA). EPA requirements such as National Pollution Discharge Elimination Systems (NPDES) permits, which regulate point source water discharges, were applied in 1975.

Although PSAPCA began regulating sulfur dioxide and arsenic emissions in 1968, variances to the standards were granted to Asarco until 1975. EPA began enforcement proceedings in the early 1980s to regulate air emissions. Federal and state standards anti variances continued to be issues of contention until the smelter closed in 1985.

In July of 1983 EPA issued proposed standards for arsenic under Section 112 (National Emission Standards for Hazardous Air Pollutants) of the Clean Air Act. Inorganic arsenic had been designated as a hazardous air pollutant in 1980 and the Asarco smelter was a major source of arsenic. The proposed standard for Asarco, requiring hoods on the converters used in the smelting process, was modified after public comment to require, in addition to the hoods, better management practices in handling arsenic contaminated materials. These regulations were never implemented due to a decision by Asarco to cease copper refining in 1985.

In September 1986, Asarco signed an Administrative Order on Consent (AOC) with EPA pursuant to

Section 106(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), in which Asarco agreed to conduct a Remedial Investigation and Feasibility Study (RI/FS) and perform immediate site stabilization activities. Asarco's contractors began the RI/FS in 1987 under EPA oversight. Site stabilization, Phase I and II, were both conducted based on the information collected during the initial investigation of the Site.

In December 1990, EPA issued a ROD for demolition of structures and construction of a surface water diversion system. Asarco agreed to perform this work in a consent decree dated May 18, 1992.

The field investigation and evaluation of remedial alternatives for a final RI/FS was concluded by Asarco in January 1993 and was used to develop a final Site remedy.

In addition to the smelter property itself, Asarco is a responsible party for three closely related OU of the CB N/T Superfund Site, known as Ruston/North Tacoma Study Area, Asarco Sediments and Demolition. These units are reviewed below in the Section 4.0, "Scope and Role of Operable Units."

The following is a brief chronological summary of enforcement activities associated with the former Asarco Tacoma smelter.

- 1986 AOC for RI/FS and Phase I site stabilization signed.
- 1988 Phase I Site stabilization (demolition) activities completed.
- 1989 Draft RI/FS submitted.
- 1989 AOC for Expedited Response Action in Ruston/North Tacoma signed.
- 1990 Notice of Violation for RI/FS issued.
- 1990 Interim ROD for Phase II Site stabilization (demolition) and surface water controls issued.
- 1991 Additional investigation of soils and groundwater contamination commences.
- 1992 Notice of Violation resolved.
- 1992 Consent Decree for demolition entered in federal court.
- 1992 Fifth Amendment to the 1986 AOC revising the schedule for the draft and final RI/FS submittals signed.[1]
- 1993 Two stipulated Penalties for late draft FS submittals paid by Asarco.
- 1993 ROD for Ruston/North Tacoma Study Area issued.
- 1993 Unilateral Administrative Order for Ruston/North Tacoma Study Area issued.
- 1993 Final RI/FS reports for smelter cleanup submitted and approved.
- 1994 AOC for Ground Water, Surface Water, Soil and Marine Sediments monitoring and sampling signed.

1 Amendments 1-4 for the AOC also included revised schedules for the performance of RI/FS work.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Throughout the studies leading up to this ROD, EPA has taken steps to inform and involve the public about activities at the Asarco Smelter site. EPA conducted the activities summarized in this section because the agency believes that community involvement in its decision making process is a key element in developing a successful cleanup plan.

In addition to cleaning up contamination at the Asarco Site, the community is very interested in the future use of the property. Although it is EPA's primary mission to design a cleanup plan that protects public health and the environment, EPA believes this can be done with future development of the Site in mind. Therefore, EPA has considered all comments related to the future of the Asarco Site when selecting cleanup actions.

In order to provide a variety of opportunities for public participation in the cleanup decision making process, EPA developed a communications strategy in 1993 for its activities related to the Asarco Site. This strategy supplemented the existing Community Relations Plan, which included all of the Commencement Bay Nearshore/Tideflats and South Tacoma Channel Operable Units.

This section summarizes the outreach activities that EPA has conducted to date. In addition to the activities discussed below, EPA has complied with the specific requirements for public participation under CERCLA by publishing a Proposed Plan for public comment on August 12, 1994. The Proposed Plan was mailed to interested individuals and made available at local information repositories (listed in Table B-1 in Appendix B). The original public comment period ran from August 12 through October 11, 1994, and was extended until November 10 at the request of interested citizens. During the comment period EPA held two public meetings. In addition, a summary fact sheet was mailed to EPA's mailing list for the Asarco Site. EPA also published newspaper advertisements in the Morning News Tribune to announce the availability of the Proposed Plan, the comment period and the public meetings. Comments received during the public comment period are summarized along with EPA's responses in the attached Responsiveness Summary.

In addition to the public comment period, the following outreach activities were conducted by EPA:

Small Group Meetings. EPA staff members have attended meetings with groups upon request to share information about the agency's cleanup proposal, and to learn about different groups concerns and needs for information about the Site. These groups include: Black Collective Association; Izaak Walton League; Association of Builders and Contractors; Tacoma Environmental Commission; National Association of Women in Construction; Association of General Contractors; American Institute of Architects Southwest Washington; Environmental Task Force of Tacoma-Pierce County Chamber of Commerce; Kiwanis Club and Rotary Club.

EPA staff will continue to meet with small groups as requested.

Community Interviews. In November 1993 EPA staff met with individual citizens to understand better community concerns regarding cleanup.

Availability Sessions. In October, November and December 1993, EPA and Asarco held sessions where citizens could visit one-on-one with EPA and Asarco staff to discuss cleanup plans.

Community Workgroup Briefing. On May 19, 1994, EPA held a meeting for the Ruston/North Tacoma Community Workgroup. This workgroup was formed in 1989 to provide an avenue for citizens to become involved in residential investigation and cleanup activities. EPA presented a preview of its Preferred Cleanup Alternative at the meeting in order to get feedback and comments from the group.

Public Meeting. EPA held two public meetings during the 90-day public comment period on the Proposed Plan. At the meetings participants learned more about EPA's Proposed Plan and had the opportunity to provide public comments. Transcripts were taken of these two meetings (held August 30 and September 19, 1994) and are available in EPA's Administrative Record for the site.

Periodic Briefings. Briefings have been held for the Town of Ruston, City of Tacoma, Tacoma Environmental Commission, Congressman Dicks' Office and other interested local government officials.

Information Repositories. EPA has established and updates ten repositories where citizens can review detailed information about EPA's Superfund activities. New materials are periodically added to these repositories. Documents subject to public comment can also be found in these locations. The repositories are frequently advertised in fact sheets and in newspaper notices prepared by EPA.

Fact Sheets and Brochures. EPA prepares regular fact sheets for distribution to members of the community to provide current information on the status of site activities. Table B-2 in Appendix B, identifies a list of fact sheets and brochures published about the Asarco Site prior to this ROD.[2]

Coordinating Forum. In July of 1993, the Ruston/North Tacoma Coordinating Forum turned its attention to evaluating cleanup options for the Asarco Tacoma Smelter. The group was originally formed in March 1991 to facilitate discussion and coordination among the various entities involved and/or affected by the Ruston/North Tacoma Residential Study Area project.

2 Fact sheets devoted exclusively to demolition activities are not included in this list.

In order to address issues associated with cleanup and future redevelopment of the Asarco smelter, the group formed two subcommittees: 1) land use, and 2) technical. The two committees worked for over a year on issues related to developing a cleanup plan for the smelter site. EPA participated directly in the technical subcommittee and received input from the land use committee. Input from both of these committees was instrumental to EPA in developing the Proposed Plan, which was published in August 1994. The following parties participated in the Forum subcommittees:

Land Use Subcommittee*:

Asarco
City of Tacoma
Metropolitan Parks District
Town of Ruston

* All land use subcommittee members were also represented on the technical committee.

Technical Subcommittee:

Agency for Toxic Substances and Disease Registry
Citizens for a Healthy Bay
Community Representative
Environmental Protection Agency
Puget Sound Air Pollution Control Authority
Puyallup Tribe of Indians
Tacoma-Pierce County Health Department
U.S. and State Fish and Wildlife Services

Washington Department of Ecology
Washington Department of Health
Washington Environmental Council

Technical Assistance Grant. In 1991 EPA awarded a Technical Assistance Grant (TAG) to the Citizens For A Healthy Bay. Citizens For A Healthy Bay have used these funds to have technical experts review and comment on cleanup design documents, prepare information for the general public on cleanup work, and prepare information for non-English speaking people who may fish or work on Commencement Bay. They have an office in downtown Tacoma which is open to the public and serves as an information repository for the Commencement Bay and Asarco Superfund sites. They also publish a quarterly newsletter which covers a wide-range on environmental issues associated with Tacoma.

4.0 SCOPE AND ROLE OF OPERABLE UNITS

Superfund response activities at the CB N/T Site currently are coordinated under seven separate OUs. Four of the OUs are related to the Asarco Superfund project. They are:

OU 02 - Asarco Tacoma Smelter
OU 04 - Asarco Off-Property (Ruston/North Tacoma)
OU 06 - Asarco Sediments
OU 07 - Asarco Demolition

The remedy described in this ROD addresses cleanup of OU 02, the Asarco Tacoma Smelter. It primarily involves the cleanup of metal-contaminated soils, slag, surface water and ground water. It also addresses the final disposal of demolition debris, the Expedited Response Action (ERA) soils and the Ruston/North Tacoma residential soils.

4.1 SCOPE OF CURRENT WORK

4.1.1 OU 02 - Asarco Tacoma Smelter

Based on its evaluation of human health and ecological risks associated with existing conditions at the Asarco Site, EPA believes that current conditions on the Asarco Site pose unacceptable risks over the long-term to future potential workers, residents and visitors, and to the ground water discharging to Commencement Bay. Therefore, cleanup actions are necessary. EPA's goal is to reduce potential exposures to metal and organic contaminants by removing contaminated soils that act as source areas to the surface water and ground water, by capping the Site (soil and slag) surfaces and by armoring the slag shoreline. Soil removal or capping contaminated soils and slag is expected to reduce the contaminants that are carried into Commencement Bay by surface water and/or ground water and prevent direct contact with the soil and slag by humans and animals.

This ROD describes the final cleanup remedy for soil, Slag and surface water and disposal of hazardous soils, demolition debris and residential soils. This ROD is intended to be an interim action for ground water.

Site Development Planning

Concurrent with EPA's efforts to design a cleanup plan, Asarco, the Town of Ruston, the City of Tacoma, and the Metropolitan Park District formed a "land use committee" and hired consultants to help the group develop a Master Use Plan for future development of the Site after cleanup.

This effort involved significant citizen participation. Asarco and the land use committee held four week-long public forums called "Asarco Weeks" over an eight-month period to solicit ideas regarding the future use of the Asarco property. These efforts resulted in an "Agreement in Principle," negotiated by Asarco, the City of Tacoma, the Town of Ruston, and the Metropolitan Park District of Tacoma, that outlines a proposal for development of the Asarco Site, including responsibilities among the signatories for such development.

The "Agreement in Principle" adopts the "G-2.1" concept, the consensus approach resulting from the Asarco Weeks, and provides general guidelines for open space and development zones, such as commercial, residential, recreational, marine, and mixed uses, and for surface roadways. The G-2.1 concept provides for a park centered on the Site with a setback traffic center and a crescent-shaped development area fronting on grassy areas facing Commencement Bay. The park would tend from Ruston Way to Point Defiance Park.

Although the "Agreement in Principle" and this ROD are separate documents, they contain some common elements. They are separate because they represent different objectives and types of decisions regarding the smelter property. The purpose of the ROD is to document EPA's cleanup decision for the Site. Under the Superfund law, EPA has the authority to select and implement cleanup actions. In contrast, the "Agreement in Principle" outlines a proposal for development of the property after cleanup. The property owners, Asarco and the Park District, and the local governments with jurisdiction over the property, Tacoma and Ruston, have the authority to determine how the property can be used in the future after the cleanup has been completed.

4.2 OTHER RELATED ACTIVITIES

4.2.1 OU 04 - Asarco Off-Property (Ruston/North Tacoma Study Area)

The initial action for the Ruston/North Tacoma Study Area was an ERA. In March 1989, Asarco and EPA entered into an agreement for Asarco to conduct the ERA in the Ruston/North Tacoma Study Area. The AOC issued under Section 106(a) of CERCLA, required Asarco to clean up and cap 11 publicly accessible properties in Ruston. Contaminated soils excavated from all of the properties are stored temporarily at the Site in a building known as the "fine ore bins building."

In June 1993, EPA issued a ROD requiring that arsenic and lead contaminated soils in residential yards and in public right of ways surrounding the former smelter facility be excavated or capped and disposed off-site. In November 1993, an Explanation of Significant Difference (ESD) was available for public comment and was subsequently signed by EPA, allowing for temporary storage of the Ruston/North Tacoma residential soils on the north end of the former smelter property. The ESD provided for these soils to be left on the former smelter site until either the final Site remedy was selected or until December 31, 1994. EPA issued a Fact Sheet in December 1994 stating that, in general, the community supported disposing these soils on site as a sub-base for a cap and that these soils would remain on site until the final smelter remedy was selected.

By the end of 1994, 75 private properties had been cleaned up and 269 yards had been sampled.

4.2.2 OU 06 - Asarco Sediments

EPA issued a Supplemental Feasibility Study for the off-shore sediments in summer 1993. However, EPA, Ecology, Asarco, the Natural Resource Trustees and a community group believed that additional investigations and evaluation of the cleanup actions were necessary. In 1994, Asarco and EPA entered into an AOC requiring Asarco to collect and evaluate additional information regarding the off-shore marine sediments.

4.2.3 OU 07 - Demolition end Surface Water Controls

In November 1994, Asarco completed Phase II demolition of remaining Site structures under a federal Consent Decree signed in 1991 with EPA. Also under the Consent Decree, Asarco controls surface water that runs onto the Site to minimize the contact of surface water with contaminated soil in the cooling pond.

The remainder of this ROD discusses only the source control activities for cleanup of OU 02, the former Asarco Smelter, and the final disposal of demolition debris, the ERA soils and the Ruston/North Tacoma residential soils.

5.0 SUMMARY OF SITE CHARACTERISTICS

Under EPA's oversight, Asarco collected and analyzed soil, slag, surface and ground water, and sediment samples at the Site.

Soil. The following contaminants were found in soils on the Site at levels that were of potential concern to human health and the environment:

Metals
Antimony, Arsenic, Cadmium, Copper, Lead, Mercury, Silver, Thallium, Zinc

Organic Chemicals
Polyaromatic Hydrocarbons (PAHs) and Polychlorinated Biphenyls (PCBs)

These contaminants in soil are of concern because (1) they are the primary source of contamination to ground water and surface water that is flowing into Commencement Bay; and (2) they are a potential health concern for humans and animal life that be exposed to the contaminants in the soil now or in the future.

Samples show that the principal threats to human health and the environment posed by the Asarco Site are the contaminated materials in the six "source areas" identified on Figure 1-1.

These are areas that have either the highest measured concentrations of contaminants in the soils, appear to act as the primary known sources of contamination to ground water and surface water, and/or have large amounts of contaminated material based upon the historic uses of these areas.[3] These areas are the:

- Stack Hill
- Copper Refinery Area
- Cooling Pond
- Fine Ore Bins Building
- Arsenic Kitchen
- Southeast Area of the Plant

3 For example, the highest concentration of arsenic found in soil is 403,100 parts per million (ppm) near the arsenic kitchen area. This level is approximately 130 times higher than the highest concentration found in Ruston. The highest concentration of arsenic in ground water is located in monitoring well 111 with 52 ppm (.006 parts per million is EPA's preliminary remedial action objective). This monitoring well is down-gradient from the arsenic kitchen and fine ore bins area. See Table 3 for maximum concentrations of chemicals of concern.

Soil and groundwater concentrations in the source areas are identified for both arsenic and copper in Tables B-3 and B-4, respectively, in Appendix B.

In addition to these six areas, elevated concentrations of metals were detected in soils and slag throughout the entire property. Even though certain areas are not considered principal threats to ground water, the concentrations generally are high enough throughout the Site to pose a threat if they are inhaled, ingested, or touched by people or animals.

Slag contains high concentrations of metals, including arsenic and lead, in a rock-like form. Concentrations of arsenic found in slag ranged from 100 to 24,950 ppm. The slag along the smelter shoreline is a poured matrix. The slag found on the slag peninsula is primarily fine grained, sand-like particles. The slag portions on the Site appear to contribute less contamination to ground water than the source areas described above. Slag poses a threat if ingested by people or animals. In addition, the fine slag particles on the peninsula are blown into Commencement Bay and potentially into the recreational areas of the Yacht Basin and Point Defiance Park.

The face of the slag shoreline appears to be impacted by the tidal activity in Commencement Bay. High energy currents and wave action cause erosion of the slag, which results in slag particles moving from the shoreline and being deposited into the off-shore sediments. Recently, a shoreline monitoring station was washed away.

Surface water samples were collected from seeps (ground water that surfaces from hillsides or in the tunnel), puddles, and at the outfalls that discharge into Commencement Bay. Asarco found that surface water on the Site, including seeps and small stagnant pools below the stack hill and in the arsenic kitchen area, and water in the cooling pond, is contaminated with metals at levels higher than federal or state standards for drinking water and for protection of sea life. The contaminants that exceed regulatory levels include arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel selenium, silver zinc, total petroleum hydrocarbons, and anilines.

The surface water investigation showed that the surface water drainage system on the Site is no longer adequate. The pipes and drains associated with the system may be cracked and/or the pipes filled with contaminated sediments. Surface water can become contaminated by contact with the contaminated sediments in the pipes. The contaminated surface water can then leak out of the system and migrate to ground water or discharge to Commencement Bay.

Ground Water. Three water-bearing zones (groundwater aquifers) were identified at the smelter property. The two shallowest aquifers, the slag and marine sands aquifers, show elevated levels of arsenic, copper, zinc, and other metals. A thick silt barrier between the shallow and deeper aquifers seems to have protected the deeper aquifer, the Pre-Vashon aquifer, from contamination. Only a few water samples from the deeper aquifer have elevated metal concentrations. The few exceptions may result from contamination migrating through a production well, which was drilled into the deeper aquifer during the smelter's operation. This well has now been plugged so that contamination is unlikely to continue migrating from this well into the deeper aquifer.

The three primary ways for metals to move into ground water are: (1) clean or contaminated surface water moving through contaminated soil into ground water; (2) contact between ground water and soil or slag that releases metals into ground water; and (3) leakage and spills, for example, from former process operations such as ore handling, storage, or refining, and from the existing sewer and drainage system.

Organic contamination caused by dimethylaniline (DMA) that was used in the production of sulfuric acid has been identified in the southeast comer of the smelter property. Wood debris and sawdust, left over from sawmill operations and now buried beneath the slag, are decomposing thus contributing to the release of metals, particularly arsenic, from the slag into ground water and Commencement Bay.

The metal levels in ground water decrease as ground water moves through the smelter property towards Commencement Bay. This decrease in contamination may be due to: (1) seawater or groundwater dilution; (2) metals adhering to the slag as ground water moves towards the bay; (3) metals being removed from the ground water through chemical reactions; or (4) the contaminant plume moving slowly through the smelter property.

The contaminants that exceed regulatory levels for ground water entering the bay are: arsenic, beryllium, cadmium, copper, lead, mercury, nickel, selenium, silver, zinc, total petroleum hydrocarbons, and anilines.

Air. Samples of dust were collected at 22 smelter property locations. A model was used to predict how much dust would move into the communities of Ruston and Tacoma if there were no cleanup. The results showed that the highest emissions would be on the smelter property and that emission levels decrease rapidly with distance from the smelter property.

6.0 DESCRIPTION OF SITE RISKS

This section of the ROD provides a brief summary of the "On-Property Human Health Risk Assessment" (`Risk Assessment') for the Asarco Tacoma Plant (Kleinfelder 1993). The document was prepared by Asarco, with EPA oversight, to assess the potential human heath risks from Site contamination and was completed according to national and regional EPA risk assessment guidelines. It evaluates potential risk from exposure to contamination in soil, slag, surface water, ground water and air if no remedial action is taken on the site. The results of this assessment were used to decide whether remedial action is appropriate and which exposure pathways and contaminants require remediation.

OVERALL SUMMARY OF RISK ASSESSMENT

Potential health impacts were estimated using the risk assessment and assuming five possible land-use scenarios for the Site: residential, industrial, commercial, recreational and the existing non-use. The result showed that the estimated cancer risks and non-cancer health effects from the Site are the highest for possible future residents who may inadvertently ingest soils or drink ground water at the site. For example, it was estimated that the lifetime chance of developing cancer from ingesting soil in the arsenic kitchen area, assuming residential use (e.g., daily ingestion of soil, a 70 kilogram adult, living on the Site for 30 years), may be as high as two in ten. Repeatedly ingesting soil in the stack hill area may pose a chance of four in a hundred of getting cancer. An unacceptable excess lifetime cancer risk for Superfund cleanups is in a range of approximately one in ten thousand to one in a million. Non-cancer impacts from the Site are likely to present appreciable risk of significant adverse effects to people over lifetime exposures (generally referred to as a hazard index (HI) greater than one).

Residential land use poses the highest potential for health impacts because it assumes that people will spend the most time at the property and therefore potentially be more exposed to contaminants. Other land use possibilities, such as recreational, industrial, commercial, and non-use, assume people will spend less time at the Site and have lower exposures to Site contaminants. Therefore, these other scenarios are estimated to have less potential for health impacts.

Arsenic exposure is responsible for most of the estimated cancer risk from contaminants in soil, slag, ground water and surface water at the Site. Arsenic levels in the surface water and ground water that is discharged to the Bay substantially exceed EPA's water quality criteria for fish ingestion by people, and stat standards that protect marine life. Antimony, arsenic, chromium, copper, lead, manganese, and mercury are some of the chemicals of most concern for non-cancer effects such as organ damage, learning disabilities, and birth defects. A detailed discussion of all of the assumptions and the estimated numerical health impacts associated with each pathway can be found in the Risk Assessment report.

Risk assessments are performed using information on the toxicity of contaminants and assumptions regarding the extent to which people may be exposed to them. This summary of the Asarco Risk Assessment is divided into five sections: (6.1) identification of contaminants of concern (COCs), (6.2) exposure assessment, (6.3) toxicity assessment, (6.4) risk characterization, which is an integration and summary of the information gathered and analyzed in the preceding sections, and (6.5) analysis of the uncertainty involved in developing a risk assessment. In addition, Section 6.6 is a summary of the qualitative ecological risk assessment (EPA 1993).

6.1 IDENTIFICATION OF CONTAMINANTS OF CONCERN (SCREENING ANALYSIS)

The selection of chemicals that potentially contribute to risks to human health at the Site, known as the COCs, was a two-step process. First a screening evaluation was done comparing the maximum chemical concentrations in soil, ground water, and air with conservative health-based concentrations and/or with appropriate criteria and standards. The chemicals selected in this first step were then evaluated, taking into account each chemical's frequency of detection, toxicity, persistence and mobility, in order to select the final COCs in each media. These are shown in Table 6-1.

Chemicals selected for soils, Class IIB ground water (potential drinking water) and air shown in Table 6-1 were selected using exposure parameters based on residential use of the Site.

Water from Class III wells is not suitable for drinking, it contains contaminants and can migrate into the bay. The COCs for Class III ground water were selected base upon the potential for humans to be exposed to these contaminants through consumption of seafood from the bay. Five metals were selected: arsenic, beryllium, lead, manganese and mercury.

All of the metals selected as COCs in ground water and soil were selected as COCs in surface water. Arsenic and lead were selected as COCs of concern in slag based upon information from the Ruston/North Tacoma Risk assessment.

6.2 EXPOSURE ASSESSMENT

The exposure assessment estimates the type and magnitude of exposures to the COCs at the Site. It considers the current and potential future uses of the site, characterizes the potentially exposed populations, identifies the important exposure pathways and quantifies the intake of each COC from each medium for each population at risk. The result of the assessment is a calculated daily dose of each COC per body weight for each exposure medium.

6.2.1 Identification of Site Uses, Exposed Populations and Exposure Pathways

Site Use Scenarios. The exposure assessment for the Asarco Site considers five land-use scenarios involving different groups of potentially exposed populations. Of the five land-use scenarios considered, one represents the current use or "non-use," and four represent projected future uses: residential, commercial, heavy industrial, and recreational.

Potentially Exposed Populations. Each scenario described above has an associated population that may be exposed to COCs at the site. The populations assumed for each of the site uses are described below.

(1) Non-Use. Currently, the Site is not being used for any purpose other than for site investigation, monitoring and demolition. For this existing use scenario, potentially exposed populations are maintenance workers, guards, trespassers and nearby residents who may be exposed to dust from the Site.

(2) Residential. The Site would be developed for residential use. People would spend 30 years of their lifetime on the Site.

(3) Heavy Industrial. The Site would be developed for industrial purposes. Workers would spend 25 years of continuous employment at the Site.

(4) Recreational or Park. All or part of the Site would be developed as a park. Visiting children and adults would be exposed to Site contaminants.

(5) Commercial. Part or all of the Site would be redeveloped for commercial uses including office buildings and shops. Office workers and merchants would be the primary exposed populations.

TABLE 6-1. CONTAMINANTS OF CONCERN FOR SOIL, GROUND WATER AND AIR

Chemical	Soil	Drinking Water	Ground water Impacting the Bay	Air
Antimony	N	N		
Arsenic	C/N	C/N	C/N	C/N
Beryllium		C/N	C/N	
Cadmium	C/N	C/N		C/N
Chromium		C/N		C/N
Copper	N	N		
Lead	C/N	C/N	C/N	C/N
Manganese		N	N	
Mercury	N		N	N
Nickel		C/N		C/N
Selenium				
Silver	N	N		
Thallium	N			
Zinc	N			
Polycyclic Aromatic Hydrocarbons	C			
Polychlorinated Biphenyls	C			

C Cancer Causing Chemical
N Chemical Causing Non-Cancer Health Effects
C/N Chemical Causing Both Cancer and Non-Cancer Effect

Exposure Pathways. An exposure pathway is the mechanism by which chemicals migrate from their source or point of release to the population at risk. Four elements comprise a complete exposure pathway: (1) a source of a chemical release (e.g., contaminated soils); (2) movement of contaminants through environmental media (e.g., rain moving through contaminated soil into ground water); (3) a point of potential human contact with a contaminated medium (e.g., use of contaminated ground water for drinking water); and (4) entry into the body or exposure route (e.g., ingestion of drinking water).

The exposure pathways considered for the Risk Assessment varied depending on the land use being considered and on the population potentially exposed. For example, in assuming future residential land use of the Site, the following exposures were evaluated for adults and children: (1) ingestion of slag, soil, and dust; (2) dermal exposure to soil and dust; (3) ingestion of vegetables potentially contaminated by soil contaminants; (4) inhalation of contaminants in the air as a result of dust resuspension from the site; (5) ingestion of potable ground water on the Site; and (6) ingestion of contaminated surface water in pools and seeps on the Site.

In contrast, the potential exposures considered for a site maintenance worker under the current non-use scenario were: (1) ingestion of soil, dust, and slag; (2) dermal exposure to soil and dust; and (3) inhalation of contaminants in dust.

6.2.2 Calculation of Exposure

EPA's Superfund guidance requires that the reasonable maximum exposure (RME) be used to calculate potential health impacts at Superfund sites. The RME is the highest exposure that is reasonably expected to occur at the site. It is calculated using conservative assumptions in order to represent exposures that are both reasonable and protective. in the Risk Assessment, RMEs were estimated for the land-use scenarios and exposure pathways described above (see Table B-5 in Appendix B for the RME exposure assumptions for potential residential use). For the residential scenario, average exposures were calculated in addition to the RMEs to represent exposures of a more typical person.

To estimate exposure, data on the concentrations of COCs in the media of concern at Site (the exposure point concentrations) are combined with information about the projected behaviors and characteristics of the people who may potentially be exposed to these media (exposure parameters). These elements of the Asarco Site are described below.

Exposure Point Concentrations: The Site was divided into six areas to calculate the contaminant levels for estimating exposure because the Site is large, the types and concentrations of contaminants vary by area, and there are several possible future land-use scenarios, see Figure 6-1. The areas are (1) the administrative area; (2)arsenic kitchen area; (3) cooling pond area; (4) stack hill area; (5) off-plant area; and (6) general plant slag area. Section 3.0 of the Risk Assessment presents details on the calculations and use of these exposure point concentrations.

Parameters: The parameters used to calculate the RME include body weight, age, contact rate, frequency of exposure and exposure duration. Exposure parameters provided in EPA Superfund guidance were used when available (i.e., for the residential and heavy industrial land uses). Parameters for the other land uses were developed for the Asarco Site using best professional judgement.

For all of the media, except surface water, exposures were estimated assuming long-term exposures to site contaminants (e.g., 30 years of daily use for residential use, 350 days/year, and 25 years, 8 hours/day for 5 days/week, for heavy industrial use). Potential risk from surface water was calculated assuming that a child accidently consumes water that has puddled on the Site. Since there were no data on contaminant levels in Commencement Bay for fish, potential risks from the consumption of fish and shellfish were estimated by comparing the levels of contaminants in selected shoreline wells with EPA's WQC for protection of human health from fish consumption.

6.3 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. This is done by weighing available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals.

EPA has conducted toxicity assessments for many chemicals and publishes the resulting values, slope factors (Sfs) and reference doses (RfDs), on the Integrated Risk Information System (IRIS) or in the Health Effects Assessment Summary Tables (HEAST). With the exception of lead, which is assessed using the integrated uptake/biokinetic model (IUBK) developed by EPA, IRIS and HEAST were used as a source for Sfs and RfDs.

Sfs have been developed for estimating upper-bound excess lifetime cancer risks associated with exposure to potential cancer-causing chemicals. They are expressed in units of the inverse of milligrams per kilogram of body weight per day (mg/kg-day)-1. S/S are derived from the results of human epidemiological studies or chronic animal bioassays to which mathematical extrapolations from high to low dose and from animal to human have been applied, see Table B-6 in Appendix B.

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RfDs have been developed to indicate the potential for adverse health effects from ingestion of COCs that exhibit non-cancer effects, such as damage to organ systems (e.g., the nervous system, blood forming system, etc.) and learning disabilities. They are expressed in units of mg/kg-per day. RfDs are estimates within an order of magnitude, of lifetime dally exposure levels for people, including sensitive individuals, that are likely to be without risk of adverse effect. Estimated contact with contaminant(s) of concern from environmental media can be compared to the RfD (e.g., the amount of a contaminant(s) of concern ingested from drinking water or soil in mg/kg/day). Reference concentrations (RfCs) are used to indicate potential non-cancer health impacts from inhalation (usually expressed in milligram per cubic meter), see Table B-7 in Appendix B.

The standard non-cancer risk assessment method described above was not used for the assessment of lead in soil. For the residential scenario, EPA guidelines specify the use of the IUBK model for estimating acceptable lead levels in soil. EPA guidance recommends that soil lead concentrations should be low enough to ensure that blood lead levels do not exceed 10 micrograms per deciliter in 95% of the potentially exposed children. The IUBK model predicts a value of 500 ppm of lead in soil to meet this goal. The exposure point concentrations calculated for lead in soil at the Site were compared to this value of 500 ppm to assess its potential non-cancer impacts.[4]

4 Since the Risk Assessment was completed, the IUBK model has been revised. The most recent version of the IUBK model results in lead levels of 400 ppm. EPA does not believe that this significantly alters any of the conclusions in the Risk Assessment and does not have an impact upon any Site cleanup decisions.

6.4 RISK CHARACTERIZATION

Risk characterization is an integration and summary of the information gathered and analyzed in the preceding sections. Site-specific exposure estimates were combined with cancer Sfs and RfDs to assess potential health impacts.

To estimate cancer risk, the Sf is multiplied by the exposure expected for that chemical to provide an upper-bound estimate of the excess lifetime cancer risk. This estimate is the incremental probability of an individual developing cancer over a lifetime as a result of exposure to cancer-causing chemicals at a site.

The potential for non-cancer health impacts is evaluated by dividing the exposures calculated for each COC at the site by its RfD or RfC. The result is the Hazard Quotient (HQ). By adding the HQs for all contaminants via one exposure pathway, the HI is calculated.

The results of the Risk Assessment show that the estimated cancer and non-cancer impacts from exposure to Site contaminants in soil vary with the Site areas and with the projected future land-use. The estimated lifetime cancer risk from ingesting soil in the arsenic kitchen area, assuming residential land use, may be up to two chances in ten (2 in 10). Cancer risks in the other five areas of the Site, assuming residential land use, range from about 4 chances in 100 to 2 chances in a 1,000. These risks are lower primarily because contaminant levels are high in the arsenic kitchen area than in the rest of the Site.

Residential exposure to soils in the arsenic kitchen area is estimated to result in an excess cancer risk of 2 chances in 10, but the risks for the other possible site-uses (industrial, commercial, recreational and non-use) in the arsenic kitchen area range from 5 chances in 100 to 2 chances in 1,000. Residential use assumptions result in the highest risks because exposures occur more often and over longer periods of time, more exposure routes are possible and children have higher exposures than adults.

Cancer risks vary by route of exposure. For example, for residential exposures in the arsenic kitchen area, ingestion of soil contaminants results in the highest cancer risk (2 chances in 10) followed by exposure to contaminants in drinking water (about 4 chances in 100), eating vegetables (3 chances in 1,000), inhaling contaminants in dust (5 chances in 10,000) and dermal exposure to soils (5 chances in 100,000), see Figure B-1 in Appendix B.

According to the National Contingency Plan, which governs Superfund cleanup, if the cumulative cancer risk on a site is greater than approximately 1 in 10,000, a cleanup action is generally taken.

The estimated HI, which is used to evaluate non-cancer impacts, is 806 in the arsenic kitchen area assuming soil ingestion and residential land-use. HIs in this area for other land uses range from 7 to 205, see Figure B-2 in Appendix B. The HI for ground water ingestion in the arsenic kitchen area assuming residential land use is 219. HIs above 1 are used in the Superfund program to indicate that site remediation may be necessary.

Arsenic is responsible for the majority of the cancer risk at the Site. Several metals, including arsenic, lead, and copper are responsible for the non-cancer impacts at the Site.

Exposures to arsenic, copper and lead in site surface water may result in acute hazard to children who swallow this surface water. The concentrations of four metals, arsenic, mercury, manganese and beryllium, in Class III ground water near the bay are in excess (above a 1 in 10,000 cancer risk or above RfDs) of EPA's water quality criteria for protection of human health from fish consumption. Aniline is in Class III ground water at concentrations that exceed a risk of 1 in 10,000 assuming fish consumption.

Although the Risk Assessment did not include an evaluation on the adjacent slag peninsula, potential health impacts in this area are expected to be similar to those in Area 6, the general plant slag area. Area 6 was evaluated in the Risk Assessment for arsenic exposure. Assuming residential exposures, cancer risk in Area 6 may be as high as 2 in 1,000 and the HI is above 1. Therefore, both the slag peninsula and the general plant slag area contain arsenic at levels that may result in cancer and non-cancer risks above Superfund levels of concern.

6.5 UNCERTAINTY ANALYSIS

The numerical results of a risk assessment (HQs and cancer risk values) are uncertain because of limitations in knowledge regarding exposure and toxicity. Where information is incomplete, assumptions must be made: the greater the uncertainty, the more conservative the assumptions to be protective of public health. Even when actual characteristics of a population are known, selected exposure parameters are biased toward over-estimating rather than under-estimating risk for the majority of the population. A discussion is presented below on how uncertainties in the risk assessment process might overestimate or underestimate risk.

Some of the factors that may lead to a possible overestimation of risk are as follows:

(1) The majority of the soil samples were collected in areas of the Site thought to be contaminated based on past smelter operations, so the whole Site might not be as contaminated as these samples indicate;

(2) Because of a lack of information, the exposure parameters (e.g., exposure frequency and duration) used in the risk assessment are derived in a conservative manner;

(3) EPA assumes that there is a cancer risk associated with all exposures to cancer causing chemicals and that this risk increases as exposure increases. This assumption may not be true for all carcinogens;

(4) RfDs are developed from animal data using uncertainty factors to take into account the differences between animals and people and the differences in experimental versus environmental exposures. For some chemicals, these uncertainty factors may be overly conservative.

Conversely, there are factors that may lead to a possible underestimation of risk. Some of these factors are as follows:

(1) Some of the unsampled areas of the site may have higher concentrations than those areas sampled;

(2) Soil exposure assumptions were made using surface soil concentrations; some subsurface soils on the Site have contaminant levels that are higher;

(3) The lack of data available for the derivation of exposure factors and toxicity factors (Sfs and RfDs) could result in factors that are too low, although the use of uncertainty factors makes this unlikely;

(4) Estimated cancer risks for arsenic, which is the contaminant of greatest concern at the Site, may be too low. They were evaluated using the Sf in the IRIS data base, which takes into account only arsenic's ability to cause skin cancer although more recent analyses have shown that arsenic ingestion can also elevate risks of internal organ cancers; and

(5) Contribution of site contaminants to fish ingestion exposure by surface water run-off, outfalls, sediments or existing contaminants in the Bay from past Site discharges were not evaluated.

For more detail regarding uncertainty, see Section 6.0 of the Risk Assessment.

6.5.1 Comparison of the Risk Assessment Results to Superfund Regulations and Guidance

The results of the Risk Assessment are evaluated to determine if the Site needs to be cleaned up and what cleanup actions are warranted. This evaluation is made by determining whether the cancer risks and the non-cancer health impacts exceed those considered to be of concern to EPA's Superfund program as defined in EPA's National Contingency Plan (NCP) and "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions," April 22, 1991, OSWER Directive No.9355.0-30.

Where the cumulative carcinogenic site risk to an individual based on RME for both current and future land use is less than approximately one in ten-thousand, and the non-cancer causing HQ is less than 1, cleanup on a site is generally not warranted unless there are adverse environmental impacts. As described above in the risk characterization section, the cancer risks and HIs calculated were in excess of these two criteria. Based on the results of the Risk Assessment, EPA has determined that cleanup is necessary at the Site.

6.6 ECOLOGICAL RISK ASSESSMENT

EPA developed an Ecological Risk Assessment to assess the impacts of contamination on sea life, plants and pets. EPA based its assessment on available literature and Site-related data. The assessment suggests that the metals in soils may have an impact Site vegetation. Based on exceedances of federal and state water quality criteria in ground water and surface water and exceedances of state sediment quality criteria in off-shore sediments, sea life in the off-shore sediments have been adversely affected by releases from the Site.

6.7 EPA'S CLEANUP OBJECTIVES AND TWO-PHASE APPROACH

Cleanup actions are necessary because current conditions at the smelter property and on the slag peninsula pose unacceptable long-term risks for current workers, possible future visitors or residents, and sea life and animals. EPA is recommending a comprehensive cleanup strategy in order to address the multiple sources of contamination at the smelter property and slag peninsula. EPA's objectives for the cleanup are identified in Table 6-2. The performance standards for the selected remedy are found in Section 9.

EPA will accomplish its cleanup objectives at the smelter property and slag peninsula in two phases. The first phase, which is described in this ROD, includes activities to control continuing sources of contamination at the smelter property and slag peninsula. These "source control" activities will remove or control portions of the property that are known to be contributing to the contamination of surface water and ground water. Such activities will also minimize possible exposure to contamination via direct contact, and therefore further reduce Site risks.

The second phase could include additional active clean up measures, if necessary, to restore surface water or groundwater quality and will be described in a subsequent ROD. An example of an active measure would be installing a groundwater pump and treat system at the Site. Further active measures would not be necessary if ground water or surface water clean up levels are achieved as a result of the source control measures. In this case, a "no-action" ROD would be issued.

Although sampling of ground water has been conducted since 1987, EPA believes that the following significant uncertainties remain regarding how contaminants move into and through the ground water at the smelter property.

- Impacts of clean up actions on groundwater quality.
- Extent to which concentrations of contaminants in the ground water are naturally being lowered through chemical reactions currently taking place in the groundwater.
- Extent to which dilution by seawater or ground water may also be reducing concentrations of contaminants.
- Loadings of contaminants (for example, kilograms per day) discharged to Commencement Bay via groundwater pathways.

EPA will continue to require monitoring of ground water to provide a better assessment of ground water conditions, an evaluation of the effectiveness of soil and surface water clean up actions on groundwater quality and an evaluation of the practicability of groundwater remedial measures.

TABLE 6-2. CLEANUP OBJECTIVES

CONTAMINATED SOIL, DUST AND SLAG

(a) Prevent ingestion and inhalation of contaminated soils slag and dust containing contaminants in concentrations above applicable or relevant and appropriate requirements (ARARs) or above risk-based goals when ARARs are not available or protective;

(b) Reduce releases of contaminants from soil to ground water by:

) Removing the source areas where contaminants leach from soil to ground water

) Limiting the surface water that runs into soil and slag;

(c) Limit the erosion of slag to the off-shore sediments.

ON-SITE GROUND WATER AND SURFACE WATER

(a) Prevent ingestion of potable (Class IIB) ground water and On-site surface water (e.g., seeps, puddles) containing contaminants above ARARs or above risk-based levels when ARARs are not available;

(b) Reduce contact between contaminated soil, slag or fill and surface water and ground water.

GROUND WATER, SURFACE WATER, AND TREATED WATER DISCHARGED TO COMMENCEMENT BAY

(a) Reduce discharge to Commencement Bay of contaminated waters containing contaminants in concentrations above ARARs or risk-based goals when ARARs are not protective or not available;

(b) Reduce leaks and spills of contaminated surface water from drainage and sewage systems.

7.0 DESCRIPTION OF ALTERNATIVES

Asarco's Feasibility Study (FS) identified a range of alternatives to achieve the clean up objectives and remediation goals for the smelter property and slag peninsula (Table 7-1). The alternatives represent significantly different approaches to cleanup the Site and protect human health and the environment. The alternatives are different, for example, in terms of their effect on the contamination, what is necessary to maintain their effectiveness, and their cost.

The range of alternatives presents several choices for cleaning up contamination at the Site. EPA decided among the choices in order to select the cleanup remedy for the Site.

In addition to the various cleanup alternatives identified below, demolition of the remaining buildings and structures on the Site and use of the Ruston/North Tacoma residential soils as a sub-base for the Site wide cap were evaluated. In addition to the cleanup alternatives selected, long-term operation and maintenance of the cleanup activities and coordination with Site redevelopment is necessary.

The following section summarizes the cleanup activities under each of the FS alternatives and their estimated costs.

7.1 SUMMARY OF ALTERNATIVES

Plant Site-Soils (and Slag Peninsula)

Several cleanup alternatives were evaluated in the FS for plant site soils (PSS), slag at the plant site, and the slag peninsula.

PSS-1 is "no action." This alternative means that no further cleanup actions would be performed. This alternative is included to serve as a baseline for the evaluation of other alternatives.

PSS-2 is "limited action" and would focus on restricting access to the Site by fences with warning signs and deed restrictions to prohibit wells from being drilled into contaminated ground water and future use or development on the Site. The estimated cost of this alternative (capital plus operation and maintenance) for both PSS and the slag peninsula is $1.5 million and the estimated time to install fencing and warning signs is one month ($1.5 million and one month).

PSS-3 includes two types of caps for the plant site and slag peninsula and three different possibilities for excavation and disposal of soil. In general, the purposes of a cap are to prevent the direct contact of people, animals, and surface water with contaminated soils and slag, to prevent contaminated soil from being wind-blown, and to reduce movement of soil contaminants through surface water into ground water. A cap can also be used to make drainage/grade improvements and to prevent contaminated surface water from pooling on the Site.

Caps:

PSS-3A A low permeability (10-7 seconds/centimeter) asphalt cap on areas of the plant site and the slag peninsula that are not currently paved ($6.3 million and three months).

PSS-3B Soil cap over entire plant site and the slag peninsula that includes a Ruston/North Tacoma residential soils sub-base, low-permeability clay layer, gravel drainage layer, and clean topsoil, see Figure 7-1 ($7.6 million and five to seven years).

Excavation/Disposal:

PSS-3C Excavate soil and granular slag from the source areas (see Figure 1-1); dispose of materials, together with demolition debris and Study Area soils, in an OCF, a hazardous waste landfill with a low permeability liner and cap, leak detection, collection and removal system, leachate collection and removal system and surface run-on and run-off control systems, located in the current parking lot, see Figure 7-2. ($23.5 million and seven years).

PSS-3D Same as PSS-3C but dispose excavated materials in an OCF located in the plant slag area ($23.7 million and seven years).

PSS-3E Excavate, treat, and dispose source area soils and demolition debris in an off-site hazardous waste landfill ($75 million and six months).

Estimates of Materials To Be Excavated (in cubic yards)*

- Arsenic Kitchen 62,000.00
- Cooling Pond 18,100.00
- Stack Hill. 54,000.00**
- Copper Refinery 14,050.00
- Fine Ore Bin. 9,850.00
- Demolition Debris . . . 82,000.00

SUBTOTAL 240,000.00

- Residential Soils . . . 187,000.00

TOTAL 427,000.00

* The Southeast Area of the Plant is not included because it is not practicable to excavate the wood debris buried in slag that is contaminating the ground water, see Section 8 - Implementability.

** This estimate includes 39,700 cubic yards from and around the car and railroad tunnels.

TABLE 7-1. CLEANUP ALTERNATIVES

Plant Site Soils (PPS)

PSS-1 No Action (used for comparison).
PSS-2 Limited Action (fences and warning signs).
PSS-3 Capping and/or Soil Excavation

PSS-3A Asphalt cap over unpaved areas on Site and slag peninsula.

PSS-3B Soil cap over entire Site and slag peninsula.

PSS-3C Excavate soil from some areas and dispose in OCF in parking lot.

PSS-3D Excavate Soil from source areas and dispose in OCF in plant slag area.

- Bermed structure in parking lot.
- Three linear concrete cells with vertical walls in NE arsenic kitchen area.
- Circular concrete tank, 525 feet in diameter in arsenic kitchen area.
- Circular bermed structure, 600 feet in diameter, in NE arsenic kitchen area.

PSS-3E Excavate soil from source areas, treat and dispose in offsite landfill.

PSS-4 Treating Soil from Source Areas:

PSS-4A Treat soil, put back treated soil in excavated areas, dispose demolition debris in OCF.

PSS-4B Treat soil, dispose treated soil in offsite landfill, dispose demolition debris in OCF.

Surface Water (SW)

SW-1 No Action (used for comparison).
SW-2 Monitoring Program
SW-3 Cleanup Existing Surface Water Drainage System:

SW-3A Repair leaks and abandon unused portions.

SW-3B Abandon entire system. Construct new drainage system.

SW-3C Slip line existing pipes.

SW-3D Re-route surface water to alternate outfalls.

SW-4 Collect and Treat Surface Water.

Shoreline Armoring

- Riprap (place rocks on shoreline).
- Artificial beach nourishment (sand and gravel).

Ground Water and Marine Sediments

- Additional monitoring and sampling.

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Additional On-Site Disposal Alternatives:

After completion of the FS, Asarco submitted further alternatives for constructing an OCF with a capacity of 240,000 cubic yards as follows:

- Bermed structure in the parking lot built into the hillside and bermed on three sides (estimated cost is $18 million), or

- Three concrete cells in a row with vertical walls located northeast of the arsenic kitchen area. The approximate size of each cell is 200 by 1200 by 45 feet high ($32 million), or

- Circular concrete tank, about 525 feet in diameter, located northeast of the arsenic kitchen area ($22 million), or

- Circular bermed structure, about 600 feet in diameter, located northeast of the arsenic kitchen area ($22 million).

Soil Treatment:

The two PSS-4 alternatives involve treatment of contaminated soils at the plant site using chemical fixation and disposing of them in different locations. Chemical fixation means mixing excavated contaminated materials with cement and lime in order to reduce the mobility of the contaminants.

PSS-4A Put back treated soils in excavated areas on-site and cover the area with a cap. Demolition debris would be disposed in an OCF ($48.2 million and six months).

PSS-4B Dispose of treated soils in an off-site landfill and demolition debris in an OCF ($86.4 million and six months).

Surface Water

Several cleanup alternatives were evaluated to address contaminated surface water at the Site.

SW-1 is no action.

SW-2 relies on soil removal and groundwater remediation to reduce the release of contaminants (for example, arsenic) to surface water. A surface water monitoring program would evaluate the effectiveness of this approach. The estimated cost of the monitoring program is $943,000 and the estimated duration is ongoing.

SW-3 consists of four different measures with respect to the existing surface water drainage system:

SW-3A Repair leaks in the existing system; ongoing maintenance to prevent leaks in the future; plug and abandon portions of the existing system not used ($737,000 and three months).

SW-3B Plug and abandon the entire existing system. Construct new drainage system, including pipes, inlets, and manholes, that prevents leaks and resists corrosion ($1.6 million and 3 months).

SW-3C Insert smaller PVC pipe (or slip lines) into existing pipelines; seal existing drains and sumps and manholes; replace open ditches with new pipes ($969,000 and three months).

SW-3D Re-route surface water that runs onto the Site to alternate drain outfalls ($439,000 and two months).

SW-4 would collect and treat contaminated surface water in a water treatment plant located on the plant site ($23.6 million and ongoing).

Shoreline Armoring

The most effective measure to prevent erosion of the slag shoreline into Commencement Bay is called shoreline armoring.

There are two main types of armoring:

- Line the shore along the smelter property and the slag Peninsula with riprap (large rocks) underlain with 2 feet of smaller rock, see Figure 7-3. Riprap would not be installed on the interior portion of the slag peninsula because of the minimal slag erosion which occurs there ($6.2 million and from six to twelve months).

- Use artificial beach nourishment, which consists of depositing sand and gravel to form a pebble beach. Sand and gravel that erodes would need to be replaced on an annual basis ($1.4 million and two months for beach nourishment).

Mitigation for damage caused to natural resources (e.g., intertidal habitat) would be required for either of these options. The full extent and design of armoring is presently unknown, so the cost to complete mitigation (e.g., replacement of damaged resources) is not estimated. The time to complete mitigation could be up to 2 years, which could be done concurrently with or immediately after shoreline armoring.

7.2 SIGNIFICANT PUBLIC COMMENTS AND ADDITIONAL ANALYSES

EPA received many comments on its Proposed Plan for cleaning up the site. These comments are responded to in the Responsiveness Summary (Appendix A). In this section, EPA summarizes some of the most significant technical comments and describes the additional analyses that EPA conducted in response to such comments.

7.2.1 On-Site Containment Facility Comments

Several commenters recommended that if the OCF were selected, it should be comprised of multiple cells holding different concentrations of contaminated soil. The reasons given for an OCF with multiple cells were that it would provide one more level of protection against leaking, provide more precise monitoring capabilities, and be easier to remove soil in the future should an innovative treatment technology become available.

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Although there may be situations where multiple cells are appropriate for hazardous waste landfills, EPA does not agree that multiple cells are warranted for the OCF for this Site for several reasons.[5] First, the contaminated soil and debris that will be disposed is contaminated only with metals rather than a mixture of metals and organic contaminants. Therefore, even though a wide range of metal concentrations found is in soil, adverse reactions caused by different types of contaminants mixing together within the OCF are not likely to occur. Another reason adverse reactions are not expected is that contaminants leaching out of the soil are expected to decrease once the OCF is closed (i.e., when the contaminated soil and debris is isolated from surface and ground water).

5 The reasons that landfills are normally separated into multiple cells is to (1) separate incompatible wastes and the leachate from those wastes and (2) to limit the open portion of a large landfill that will operate over many years so as to limit the area available for collection of precipitation. Under this scenario, each cell would be constructed and covered prior to constructing another cell. Neither of these reasons are relevant to the Asarco OCF as the waste to be placed is not incompatible and the time the OCF will be open is short.

EPA does not agree that multiple cells would allow for more precise monitoring of down-gradient ground water. The reason is that wastes with the same contaminants would be disposed in each of the cells so in the event that leachate move through the OCF liners and reaches the ground water it would be difficult to identify from which cell it came.

Operation and maintenance of several leachate collection and removal systems due to multiple cells would be more difficult than operating a single cell leachate collection and removal system. EPA does not believe that operating multiple leachate systems would significantly increase the effectiveness of the OCF. Finally, there do not appear to be any new promising treatment technologies on the horizon that would justify disposing soils with different levels of contamination in separate cells.

7.2.2 Soil Treatment Comments

Other commenters recommended that contaminated soil should be treated prior to disposing it in the OCF. The basis for this recommendation was to provide more protection should part of the OCF fail in the future and to be consistent with land disposal restrictions (LDR), which require treatment prior to disposal.

In response, EPA performed an analysis to determine whether treating soils prior to disposal in an OCF is necessary. EPA compared the potential for contaminants leaching from an OCF into underlying ground water if soils were not treated versus if some (15 percent) of the soils were treated. EPA used 15 percent to represent the percentage of soils that are most highly contaminated.

First, EPA assumed that the OCF had a "good" liner and a "good" cap, meaning that the liner and cap conformed to landfill performance requirements. EPA compared estimated leachate rates from this OCF if soils were not treated versus if 15 percent of soils were treated. In both cases, the predicted contaminant loading to ground water was minimal. Treatment did not provide a significant advantage in effectiveness.

Second, EPA assumed that the OCF had a "poor" cap and no liner. Again, EPA compared estimated leachate rates for no treatment versus 15 percent treatment. The predicted rate for no treatment was 106 grams of arsenic per day and the predicted rate for 15 percent treatment was 93 grams of arsenic per day. EPA concluded that this difference is not significant and that treatment did not provide an advantage in effectiveness (but the analysis does show that maintenance of the OCF's cap and liners is important). See Appendix D.

Based on this analysis, EPA believes that treating soils prior to disposal in a properly maintained OCF is not necessary.

In response to the LDR comment, EPA's policy is that waste that is consolidated within an area of contamination is not "placement" and therefore does not require compliance with LDRs (i.e., treatment prior to disposal).

After the Proposed Plan was issued, Asarco submitted its final treatability analysis. One conclusion was that treating soils results in a 30 to 60 percent increase in the volume of soil. The analysis also reported results of additional TCLP and water leaching tests conducted on the treated soil. The TCLP data taken 28 days after treatment, although well below regulatory levels, is slightly higher than data taken immediately after treatment. It is not certain whether this indicates that treatment would be less effective over time in immobilizing contaminants. However, favorable results were obtained from water leaching tests, another measure of the effectiveness of stabilization/solidification. Asarco's analysis is in the administrative record.

7.2.3 Shoreline Armoring Comments

Several commenters questioned whether the slag shoreline was eroding, whether the eroded slag particles caused an adverse impact on the adjacent marine environment, and why the shoreline needed to be armored as it is already providing a suitable habitat for marine biota. If shoreline armoring was determined to be necessary, commenters also questioned how it would be anchored to the existing slag face and why riprap (large rocks) was selected instead of artificial beach nourishment (small rocks and sand) to armor the slag.

The need for shoreline armoring is based on the visual observation that slag is eroding in several locations along shoreline and on a report published by Battelle (Crecelius 1986) that showed that metals released from freshly exposed slag are toxic to marine organisms for up to three to four months. After evaluating the comments received, EPA still believes that some amount of shoreline armoring will be necessary. However, EPA has determined that before the design of the shoreline armoring begins additional data should be collected to determine (1) the extent of shoreline erosion; (2) how and where armoring should be placed; and (3) the impact of armoring to the existing marine biota versus the impact of not armoring slag to the marine biota over time.

After reviewing the most recent literature and discussing riprap versus artificial beach nourishment with the Corps of Engineers, EPA believes that the marine environment off-shore of the Asarco Site would not support artificial beach nourishment due to the high wave energy and fast currents in the area (See memo by ROY F. WESTON, Inc. in the Administrative Record, Section 2.4.1).

8.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

EPA uses nine criteria to identify its preferred alternative for a given site or contaminant. With the exception of the no action alternative, all alternatives must meet the first two "threshold" criteria. EPA uses the next five criteria as "balancing" criteria for comparing alternatives and selecting a preferred alternative. After public comment, EPA may alter its preference on the basis of the last two `modifying' criteria.

This section evaluates both the alternatives developed by Asarco (described in Section 7.0) and the remedy selected by EPA (described in Section 9.0) based on the nine criteria described in Table 8-1. The purpose of this evaluation is to highlight the most significant advantages and disadvantages of the alternatives in relation to each of the nine criteria (a more detailed evaluation is provided in Table 5-4-1 of Asarco's FS).

All nine criteria are important; but they are weighed differently in the decision-making process depending on whether they describe a required level of performance (threshold criteria), provide for consideration of technical or socioeconomic merits (balancing criteria), or involve the evaluation of non-EPA reviewers that may influence an EPA decision (modifying criteria). The modifying criteria are generally considered in altering an otherwise viable alternative.

The no-action and limited action alternatives, discussed in Section 7.0, are not protective of human health and the environment and thus are not further evaluated under the nine criteria. Neither alternative effectively addresses contaminants moving into the ground water even though human health may be somewhat protected through administrative or legal measures identified under "limited actions."

(1) Overall Protection of Human Health And The Environment

The key factor in evaluating the overall protection provided by each of the alternatives is the extent to which an individual's exposure to contaminated soil, slag or surface water is reduced or eliminated and the extent to which the contaminants moving into surface water and ground water are reduced or eliminated.

Plant Site Soils. Asphalt and multi-layer soil caps are protective because they reduce direct contact with contaminated soils and prevent wind-borne releases. Caps also reduce the migration of contaminants from soil to surface water or ground water by reducing surface water flowing through the soil. The more impermeable a cap is, the less surface water will penetrate the cap.

TABLE 8-1. EPA'S NINE EVALUATION CRITERIA

THRESHOLD CRITERIA

1. Overall protection of human health and the environment - How well does the alternative protect human health and the environment, both during and after construction?

2. Compliance with federal and state environmental standards - Does the alternative meet all ARARs and state and federal laws?

Alternatives that are not protective or do not attain ARARs are not evaluated further under the remaining criteria.

BALANCING CRITERIA

3. Long-term effectiveness and permanence - How well does the alternative protect human health and the environment after completion of cleanup? What, if any, risks will remain at the site?

4. Reduction toxicity, mobility, or volume through treatment - Does the alternative effectively treat the contamination to significantly reduce the toxicity, mobility, and volume of the hazardous substance?

5. Short-term effectiveness - Are there potential adverse effects to either human health or the environment during construction or implementation of the alternative? How fast does the alternative reach the cleanup goals?

6. Implementability - Is the alternative both technically and administratively feasible? Has the technology been used successfully on other similar sites?

7. Cost - What are the estimated costs of the alive?

MODIFYING CRITERIA

8. State acceptance - What are the state's comments or concerns about the alternatives considered and about EPA's preferred alterative? Does the state support or oppose the preferred alternative?

9. Community acceptance - What are the community's comments or concerns about the preferred alternative? Does the community generally support or oppose the preferred alternative?

Soil excavation in source areas would significantly reduce migration of contaminants to ground water and would, therefore, be protective of off-shore sediments and sea life. Disposal of soils in an appropriate disposal facility, either on site or off site, would prevent direct contact to humans or animals and prevent releases to the environment in the future. Off-site disposal would be protective of ground water and nearby populations because it would permanently remove contaminated source area soils off the Site. An on-site disposal facility (OCF) in the parking lot area, on the plant slag, or in the arsenic kitchen area can be designed with the appropriate engineering measures and institutional controls to minimize or eliminate direct contact with the contaminated soils disposed in it. These measures will also reduce the potential for releases to the environment from the OCF. The OCF is a permanent disposal facility for soils and debris. Treatment of soils would also significantly reduce the potential for the release of chemicals into the environment.

Using the residential soils as a sub-base for a cap is protective because the soils would be placed under a low permeability clay layer and soil cap. The appropriate institutional controls would prevent disturbances of the cap. These soils have not been found to leach above regulatory levels.

In addition, these soils will be disposed on top of the non-source area soils and slag that are not located near ground water. Residential soils contain significantly lower concentrations of contaminants than the material they will be placed on. Therefore, disposing residential soils on site will not add to existing groundwater contamination.

Demolition. The conventional demolition techniques for dismantling buildings, the only alternative evaluated, will be performed in a manner that is protective by first cleaning the buildings and then using dust suppression measures during the demolition activities. Any water generated during the dust suppression activities will be collected to the maximum extent practicable to prevent release into the environment. The effectiveness of dust suppression activities will be evaluated with ambient air monitoring.

Surface Water. For surface water, the replacement of the existing drainage system is protective of the environment because contact between surface water and contaminated sediments in the pipes would be eliminated. Releases of contaminated surface water to ground water through leaks in the pipes would also be eliminated. Slip-lining or repairing the existing drainage system may achieve these benefits, however, the location of all of the existing pipes is not known and many of the existing pipes may not be large enough to be slip-lined. These reductions would result in lower discharges of contaminants to Commencement Bay. The diversion of surface water run-on away from contaminated soil would also control contact between surface water and contaminated soil.

Implementation of erosion controls and other best management practices during the cleanup would control contact between surface water and newly exposed contaminated soil and reduce the transport of contaminants to Commencement Bay. Treatment of surface water would permanently reduce contaminants currently discharged through outfalls to Commencement Bay, but unless the source(s) of contamination is removed, treatment time would be indefinite.

Ground Water. Although specific active groundwater cleanup activities (e.g., pump and treat) will not be conducted during this phase of cleanup, the contaminant loading to the ground water, and to Commencement Bay is expected to decrease significantly based on soil removal, capping of the soil and slag and replacing the surface water drainage system. The potential for exposure to humans will be significantly decreased by placing deed restrictions on the property to prevent the use of ground water.

Shoreline Armoring. Both shoreline armoring and artificial beach nourishment are protective because they control the erosion of the slag shoreline into Commencement Bay and will reduce contaminant leaching from fleshly exposed slag faces.

All actions are protective except the no-action, monitoring, or limited action alternatives.

(2) Compliance With Federal And State Environmental Standards

ARARs for all of the alternatives are identified in Table B-8 in Appendix B of this ROD. The following discussion highlights the more important ARARs for this cleanup.

All alternatives will comply with ARARs except the monitoring or limited action alternatives.

Plant Site Soils And Debris. For soil, an important requirement is attaining the soil cleanup levels and complying with the requirements for selecting cleanup actions under the state's Model Toxics Control Act (MTCA).

Residential standards for soil cleanup will be attained through removal of soil from the source areas and capping the Site (see Figure 7-1 for diagram of soil cap). Institutional controls would ensure that the integrity of the cap is maintained. Construction and maintenance of a cap would allow for a variety of potential uses, including residential, recreational, and commercial uses. MTCA's requirement for selection of cleanup actions is discussed in Section 10.4 ("Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable").

Requirements for design, construction, and operation and maintenance of an OCF are set forth in federal and state law (see Section 9.9, performance standards for the OCF). Federal and state laws for hazardous/dangerous waste landfills include requirements for groundwater monitoring, closure and post-closure, and landfill design and construction.

Both EPA and the State of Washington have "Area of Contamination" policies that provide flexibility when consolidating hazardous or dangerous waste within the portion(s) of the Site that contain already-existing continuous contamination. For example, consolidation of soil and debris on site will not trigger requirements for treatment in order to comply with LDR.**7**

Under the Clean Water Act, mitigation measures must be conducted if capping or other cleanup measures will result in adverse impacts to wetlands or other natural resources.

6 A cap may not be necessary in some areas of the site if the contaminant levels remaining in the soil after excavation are below the action levels for the Ruston/North Tacoma residential cleanup (230 ppm arsenic, 500 ppm lead) or comparable levels for other contaminants as determined by EPA and Ecology. In such event, soil removal would be combined with adoption of appropriate components of the community protection measures program being used in Ruston/North Tacoma.

7 The Proposed Plan referenced the Corrective Action Management Unit (CAMU) rule. Because treatment has not been selected for the cleanup, the CAMU rule is not an ARAR.

Demolition. The buildings remaining on site will be demolished as part of this cleanup. Requirements that were used during the previous demolition phase will be applicable to the remaining demolition (see EPA's ROD dated December 31, 1990). These requirements include testing of debris to determine whether it is a hazardous or dangerous waste and, if so, handling,
storage, and disposal of such waste in accordance with federal and state standards. Temporary on-site storage of hazardous waste (e.g., materials removed from the fine ore bins building or source area soils that are excavated while the OCF is under construction) will comply with requirements for waste piles.

Surface Water. Best management practices (BMP) will be used during soil excavation to reduce contact between surface water and newly exposed contaminated soils. Examples of BMPs include sediment ponds, silt fences, diversion ditches, and cut and fill slopes.

The objective of surface water cleanup is to attain requirements for stormwater discharges and surface water cleanup standards under MTCA (see Section 9.9 for surface water performance standards). It may be necessary to establish a mixing zone to attain the discharge limitations for surface water from the point source discharges at the Site (the three surface water outfalls). A mixing zone measures compliance at a location in the surface water near, rather than at, the point of discharge and is authorized under WAC 173-201A-100. Whether a mixing zone is appropriate and, if so, the parameters of a mixing zone, will be determined during remedial design.

Ground Water. EPA will implement a two-step approach with respect to restoring ground water. The first step is removing the contaminated soils that are the sources of contamination in ground water and continued monitoring to determine the impacts of source control on groundwater quality. The second step would include further active measures to Cleanup ground water, if necessary and as feasible, to attain the required groundwater cleanup levels under MTCA.

The source control measures in the first step are in effect an interim action with respect to ground water. Because it is not certain that source control measures alone will restore groundwater quality to required levels under MTCA, EPA is using the interim measures waiver for groundwater ARARs. This means that attainment of the ground-water cleanup levels is deferred until the effectiveness of source control can be evaluated. EPA's preliminary remediation goals for ground water (see Section 9.9) will be used as benchmarks for this evaluation.

In the interim, EPA will require Asarco to implement institutional controls (deed restrictions) to ensure that ground water at the Site is not used for drinking water.

Shoreline Armoring. Under the Clean Water Act, mitigation measures must be conducted if armoring will result in adverse impacts to intertidal habitat.

(3) Long-Term Effectiveness And Permanence

Plant Site Soils. The alternatives that excavate contaminated soils in source areas would be more effective over the long-term in restoring ground water and surface water quality and preventing direct contact and ingestion than alternatives that leave such soils in place, even if capped. Permanently removing the primary sources of contamination is a key factor in cleaning up ground water and surface water.

The most widely discussed issue for this cleanup has been how to dispose the contaminated soil that is excavated from the source areas. The alternatives range from disposing the soils in an OCF, treating the soils by solidifying them using a cement and lime matrix and using the treated soil as sub-base for a site cap, treating such soils and disposing them in an on-site solid waste landfill, or transporting the soils to be disposed in an off-site hazardous waste landfill.

The following paragraphs discuss the effectiveness of each of these alternatives over time.

Plant Site Soils - Treatment. An effective treatment method for the metal-contaminated soils at the Asarco smelter is solidification/stabilization. This method does not destroy or detoxify the contaminants in the soil but rather binds the contaminated soil with lime and cement to create a concrete matrix. The contaminants are less able to migrate through the soils into other media, for example, ground water, surface water, or air.

Asarco has performed pilot tests on nearly 500 cubic yards of contaminated soil from source areas at the smelter. The results, some of which were received after the Proposed Plan was issued (see Appendix C for a summary of the report), generally show that treatment will effectively bind the contaminants for a long time. The potential for contaminants to migrate into the ground water or surface water if the treated soil comes into contact with water is expected to be minimal, if the concrete matrix remains stable.

This method of treatment, however, has been used on contaminated soils at other Sites only in the last several years. Therefore, it has not yet been proven that actual results of solidification over many years will match the predicted results from pilot tests. Also, TCLP leaching results taken 28 days alter soil treatment show a slight increase compared to TCLP results taken immediately after treatment. Although both sets of results are below hazardous waste levels, it is not certain whether this is indicative of a long-term trend towards increased leaching.

In addition, there are other long-term concerns with selecting treatment at this Site. Many of these concerns relate to the compatibility of cleanup with future uses of the Site. It should be noted that Asarco's land use plans were based on an OCF. Disposing treated soil on site is not necessarily compatible with these plans for the reasons noted below. These "disadvantages" compared to disposal in an OCF arise because land use plans based on treatment were not developed. Current land use proposals do not discuss whether the development "disadvantages" of disposing treated soils on site can be made compatible with land use plans.

The primary concern is that mixing in the treatment additives increases the volume of the contaminated soil approximately 30 to 60 percent. It is not certain that treated soil can be compacted to significantly reduce the increased volume. Because it is important that the concrete matrix remain relatively undisturbed and because the treated soil may not be stable enough to support buildings above it, disposing of an increased volume of material on site may impact plans for future construction on the property. Treated soil would have to be disposed only in areas where no construction is likely to occur.

It would also be necessary to monitor the Site to verify the continued effectiveness of treatment, Because sampling treated soil through a site cap is not recommended (punching holes through a low permeability cap is not a good practice), EPA most likely would require continued monitoring of ground water to detect whether concentrations of contaminants in ground water are increasing as a result of metals leaching out of the treated soil. If treated soil is widely dispersed on-site and problems in ground water are detected, it may be difficult to determine which specific areas of treated soil are responsible, thus making it harder to correct the problem. Disposal of treated soil in a solid waste landfill would eliminate many of the problems associated with future Site development and monitoring of the treated soils beneath a site cap.

Another concern is that the effectiveness of treatment was not demonstrated on oversize material (greater than 2 inches in diameter) such as gravel, cobbles, bricks, wood, concrete and other masonry and building debris. Whether a modified process, which could include crushing the oversize material into smaller pieces, would be effective is not known. Accordingly, it is possible that even if treatment was selected, there may still be a significant volume of oversize materials from the Asarco Site that would need to be disposed in another manner.

The last concern is that because concentrations of contaminants are not reduced, it would still be necessary to cover the treated soil with a cap. The cap would need to be inspected and maintained on a regular basis in order to ensure that people do not come into contact with the treated soil in the future. Earthquakes or landslides that affect the cap would need to be responded to in order to prevent contact with the treated soil. It should be noted, however, that because contaminated soil and slag outside the source areas will remain at the Site, a cap over the entire Site will be necessary, and will require inspections, regardless of whether treatment is used.

Plant Site Soils - Disposal in an OCF. This option calls for disposal of contaminated soil and debris in a landfill that would be constructed on site known as the OCF. The design, construction and operation of the OCF would conform to requirements for hazardous waste landfills. Three important issues are discussed in this section regarding an OCF: what type of structure will be built, how that structure will be maintained, and where it will be located on the Site.

The purpose of the OCF is to isolate the contaminated source area soils and debris in a confined area so that contaminants do not migrate into the environment. The OCF will be composed of multiple layers of clean soil and clay that are several feet thick with synthetic liners above, below and around the contaminated soil. These multiple layers serve two primary purposes: to prevent rainwater and ground water from moving into the OCF (water coming into contact with contaminated soil and debris increases the movement of contaminants) and to collect, remove and dispose of any liquids from inside the OCF. As long as these multiple layers are designed, constructed and maintained properly, the OCF will be effective over the long-term in isolating the contaminated materials. Proper design and construction of the OCF will include safeguards to prevent or minimize damages resulting from earthquakes or landslides to the maximum extent practicable.

In addition to the multiple layers of the OCF acting as a barrier to groundwater infiltration, a groundwater diversion system will be constructed in order to re-route ground water away from the OCF.

The primary disadvantage of the OCF option is that the soil and debris will not be treated and will continue to contain high concentrations of contaminants. If there is a breach of the OCF structure, the soil and debris could pose a threat to human health and the environment. Two examples of structural concerns are the finite life of the synthetic liners that will be part of the OCF structure and the potential for the cover to fail. See Section 7.2 above for discussion of EPA's analysis of whether to treat soils prior to disposal in an OCF.

In order to address these concerns, a consistent and reliable operation and maintenance (O&M) program is necessary to ensure the continued effectiveness of an OCF. Important components of the O&M program would include a leak detection system and collection and removal of leachate. The clay portion of the liner should have an indefinite life. One objective in designing the OCF will be to provide as much access as practicable to the wells and cover of the OCF for maintenance and repair.

Maintaining the effectiveness of the cover is also important. Water and wind erosion, lack of vegetation, excessive sunlight, and disturbance by animals or people are all potential problems for landfill covers. Methods to address these potential problems include burying the cover below many feet of soil, ensuring that surface water drains properly over the top of the structure, diverting ground water away from the structure, and maintaining healthy vegetation over the cap to minimize soil erosion.

A program to monitor ground water downgradient from an OCF would be required to ensure that contaminants are not moving out of the structure and into the environment. One potential advantage of the OCF over treatment is that, because the wastes will be confined to a specific area of the Site, it would be easier to monitor downgradient ground water and perhaps to identify and correct problems.

Different kinds of designs for an OCF or landfill were evaluated in the FS, such as linear/concrete cells, circular tanks, and circular bermed structures. The circular earth berm is most like a conventional landfill and it can more readily comply with the requirements for hazardous or solid waste landfills than the linear or concrete tank alternatives.

The vertical walls that are part of the linear, concrete cells would be more difficult to design and construct to meet containment requirements. Another disadvantage is that it would be more difficult to divert ground water below and around a linear system than it would be for the circular systems.

Another important issue with respect to long-term effectiveness for an OCF is its location at the Site. All of the proposed locations for an OCF would be protective of the local community and the surrounding environment. The parking lot is the closest location at the Site to existing residences. The arsenic kitchen and plant slag areas are considerably further removed from residential areas. The depth to ground water in the parking lot ranges from 40 to 90 feet, compared to approximately 6 feet in the arsenic kitchen and approximately 10 feet in the slag fill.

The arsenic kitchen area was selected as the location of the OCF because that location is most compatible with future land use plans. Because ground water is relatively shallow in the arsenic kitchen area, however, an OCF in this location would have to be well-engineered and maintained in order to be protective of ground water. "Well-engineered and maintained" refers to the liners, leachate collection and removal systems, cover, diversion system, and other components described above. For example, well-maintained impermeable and drainage layers would need to be part of the bottom liner in order to be protective of ground water.[8]

8 The bottom liner will be a double liner system. The first liner collects leachate (water that passes through the waste and is contaminated). The leachate is pumped from a trench and treated and/or removed. The second liner is below the first and collects any leachate that may have passed through the first liner.

Plant Site Soils - Off-Site Disposal Options. Another disposal alternative is transport and disposal of soil and debris in an off-site hazardous waste landfill. This would eliminate the problems described above associated with managing such waste on site. It should be recognized that slag and contaminated soil in non-source areas would remain on-site and still would have to be addressed by capping.

Plant Site Soils - Capping. The above paragraphs discussed management of soils that are significant sources of contamination to ground water. Soil and slag in other areas are believed to have a lower potential for contaminants to migrate into ground water, however, these areas still have elevated levels of chemicals for which a cleanup action is necessary. Leaving such soils in place and placing a multi-layer soil cap on top of them to reduce surface water infiltration will be the most effective in protecting surface water and ground water over the long-term. Further, the soil cap will reduce leaching in the Southeast Plant area Which is impracticable to excavate (see Section 8.6 below).

Either a soil or asphalt cap would be effective in: eliminating the risk of direct contact with or ingestion of contaminated soils and slag; preventing erosion of contaminated soil or fine grain particles of slag into Commencement Bay; reducing the extent to which surface water comes into contact with contaminants in soil and transports them directly or via ground water to Commencement Bay; and preventing the pooling of contaminated water on site. In order for either type of cap to be effective over the long-term, inspections, maintenance, and restrictions on digging below the cap would be necessary. An asphalt cap will require more inspections and maintenance than a soil cap to prevent, detect, and repair cracks and other defects.

An effective long-term solution for disposal of soil from the Ruston/North Tacoma residential cleanup is to use such soil as sub-base for the smelter site cap on top of slag. The site cap would prevent direct contact with the residential soil and reduce surface water coming into contact with the soil. A soil sub-base still would be required on the Site even if Ruston/North Tacoma residential soils were not used.

Demolition. Several buildings remain on site, such as the fine ore bins building, which is used for storage of contaminated materials, the administration building, the surface water evaporation system, and the transformer buildings. The demolition of remaining structures and disposal of the debris will remove the potential for contact with contamination in the buildings and structures. Disposal of materials stored in the fine ore bins building in the OCF (hazardous waste demolition debris, contaminated ERA soils, and calcine deposits) will eliminate the threat that contamination from the demolition debris and the calcine deposits will migrate into the environment. Materials in the fine ore bins building are suspected of contributing to groundwater contamination.

Surface Water. For cleanup of surface water, plugging and abandoning the existing drainage system and replacing it with a new surface water drainage system is the most effective approach over the long term. This alternative will eliminate releases of soil and water from the existing system into ground water and eliminate contact between surface water and contaminated sediments in the pipes.

It would be less effective to attempt to repair leaks and to clean out contaminated sediments because the location of all existing pipes is not certain. Inserting slip lines into pipes with cracks would also be somewhat effective but could not be done in all pipes due to the small diameter and deteriorating condition of some of the existing pipes. Some pipes may need to be replaced even if sliplining were selected as the remedy.

Rerouting surface water that runs onto the Site, from Ruston for example, would reduce contact with contaminated Site soil but would not affect surface water on the Site itself, i.e., rainfall. A new or repaired on-site drainage system would still be necessary.

EPA evaluated treating surface water before it discharges into Commencement Bay even before contaminated soil from the source areas is excavated. Removing the source areas is a necessary first step in any cleanup scenario. Unless the source areas are removed, treatment of surface water could be required indefinitely. Although treatment of contaminated surface water is potentially effective, it may be difficult to consistently achieve cleanup levels given the volumes of water requiring treatment, estimated to be up to 900 gallons per minute. Also, treatment of all surface water may not be possible during significant rainfalls. Bypass flow could be necessary, during such events.

Because the cleanup includes source removal, a new drainage system, and a site cap, it is likely that remaining contaminated surface water, if any, would be from off-site areas. One objective of the new drainage system would be to avoid recontamination of the site cap by surface water run-on. Also, if surface water run-on from off-site areas is contaminated, this problem may need to be addressed in the future.

Ground Water. It is anticipated that groundwater contamination will decrease over the long term because the most significant sources of the contamination will be removed and the entire site will be capped. One purpose of the site cap is to reduce surface water flow into the remaining on-site contamination soils, which should further reduce the movement of contaminants from soil into ground water.

Shoreline Armoring. The use of large rocks or boulders to armor the shoreline has a better potential to withstand current and wave action and remain in place compared to using the smaller pebbles described in the artificial beach nourishment alternative. If artificial beach nourishment were used, it would be necessary to include measures such as stone face dikes or breakwaters to decrees the effects of the currents and wave energy to prevent extensive erosion of small rocks and sand. If small rocks and sand had to be replaced frequently, recolonization of marine life would be difficult.

In addition, neither riprap nor beach nourishment are typically placed on slopes as steep as those found at this Site; a cutback would be required for either alternative. Areas that are steeper than 1 (horizontal) to 1.5 (vertical) will need a cut back. The toe of the riprap would need to be constructed 1.5 to 2 times the wave height below the water line. Established construction techniques would be used to anchor the toe and face of the armoring. Although stone faced dikes, breakwaters and revetments are commonly constructed, it is uncertain whether it will be possible to place these types of structures at the Asarco Site.

(4) Reduction of Toxicity, Mobility, Or Volume Through Treatment

Plant Site Soils and Surface Water. Soil treatment by solidification/stabilization of source area soils ranks the highest for this criterion. The mobility of contaminants in the soil would be significantly decreased by binding them up in a cement matrix. However, the toxicity of the contaminants would not be decreased and the volume of soil would increase by approximately 30-60 percent. Soil excavation and disposal in an OCF does not satisfy this requirement.

Treatment of surface water is the only surface water alterative that would reduce the mobility, toxicity, and volume of contaminants. Disposal of contaminated sludges from the surface water treatment process would be necessary.

(5) Short-Term Effectiveness

Plant Site Soils. All alternatives involving soil excavation would result in dust emissions, surface soil erosion, noise and truck traffic. Air monitoring, dust control measures (for example, wetting the soil prior to excavation) and using established transportation routes would be required to mitigate these affects. Also best management practices would be used to control surface water coming into contact with newly exposed contaminated soil. Other traffic control measures could be implemented, such as cleaning truck wheels and lining and covering truck beds when transporting contaminated materials on public roads.

Health and safety procedures would be required under all of the alternatives for workers involved with the handling of contaminated soil.

The construction of any of the alternatives for landfills would result in the short-term release of dust, increased impact of trucks and excavation equipment on site and on public roadways surrounding the site. Safety and dust controls measures would be implemented.

The primary potential short-term risk of off-site disposal is from the large number of trucks hauling material off the site. All transportation and safety requirements would be required.

Capping the soil in place with an asphalt or soil cap would pose limited short-term risks from heavy equipment movement and dust generated from grading the Site. Asphalt capping would take approximately 3 months if Ruston/North Tacoma residential soils are not used as sub-base. if all of the Ruston/North Tacoma residential soils are used as a sub-base, soil capping would take approximately 7 to 8 years. If all residential soils are not disposed ,on the site, soil capping and regrading could be completed within 12 months. Residential soil that is excavated after the cap is in place would be disposed in an appropriate off-site facility pursuant to EPA's ROD and Ecology's Dangerous Waste exemption for Ruston/North Tacoma.

The stabilization treatment system would be fully enclosed thus preventing releases of contaminants into the air and would, therefore, cause the least short-term risk. The system used during the pilot-scale study effectively controlled releases and similar measures are feasible for a full-scale project.

Demolition. The alternatives for demolishing and dismantling buildings will be effective in safely removing the existing structures. However, short-term releases of dust and particulates will result from these activities and will need to be effectively controlled. Demolition will include dust suppression measures to minimize dust emissions to ambient air and to protect workers. Air monitoring devices will also be used to determine whether air emissions exceed the standards used during previous demolition activities; if so, demolition activities will be temporarily discontinued or additional measures to reduce emissions will be undertaken as appropriate. Demolition of all remaining buildings would take 6 months, but are not likely no begin until 1996.

Surface Water. With respect to altering the existing drainage system, maintenance of the existing system would cause the least short-term risk since little, if any, soil would be disturbed. Slip lining the existing pipes would present some risks to the workers associated with routine plant site action but no adverse effects are expected in the general community. This alternative may present the most risk to the environment if sediments within the drainage pipes were pushed out of the pipes while inserting the liners. Diversion of off-site surface water run-on would present additional short-term construction risks and risks to the community since implementation of this activity would take place off of the smelter property. Plans to prevent traffic and road construction hazards would be necessary.

Completely replacing the drainage system could cause dust to be temporarily generated since some soil excavation and construction will be necessary. This would present short-term risks to site workers and the near-by residents. If the new drainage system were completely constructed within the clean soil of the cap, some of this risk (i.e., posed by contaminated soil) would be eliminated. Many of the original drainage pipes can be sealed and grouted, although, removal of some of these pipes may be necessary. In this case, some soil and/or slag excavation may be necessary. A new surface water drainage system would be installed at the same time the soil cap is being put in place, so sequencing these activities with respect to trucks and workers would be important.

All of these drainage system cleanup approaches would take 2-3 months to implement. the entire system would need to coincide with placing the cap; the other surface water alternatives would occur before the cap placement.

Surface water treatment also poses short-term risk because it would include the construction of a new surface water treatment facility and installation of a new drainage system. Even though transportation routes and operating hours can be established, more noise and truck traffic would be expected. Constructing a surface water treatment plant would take 9 months from ground breaking; it would likely be operated forever if source control measures are not also taken.

Ground Water. In the short-term, metal concentrations in ground water are expected to increase due to the dust-suppression measures (water to control dust enters the soil and moves into underlying ground water) and to the disturbance of contaminated soil within the aquifer. Generally, these higher levels are expected to decrease within a year. Regular long-term monitoring began in the spring 1994, so baseline groundwater data can be used as a reference to determine if elevated levels are temporary or if additional cleanup measures are necessary. Due to groundwater diversion measures, the volume of ground water moving through the Site may be significantly decreased; thereby temporarily increasing the concentration of contaminants because less dilution would occur.

Shoreline Armoring. Placing larger rocks (riprap) as armoring along the shoreline may result in the temporary suspension of finer-grained sediments. Temporary release of metals from newly fractured slag particles in Commencement Bay also may occur if it is necessary to cut back the angle of the shoreline in order to place the riprap. In addition, armoring with riprap would significantly impair or destroy much of the intertidal marine biota that currently exists on or along the shoreline. But riprap can be designed and constructed so that intertidal biota would recolonize this area. Placing riprap would take approximately 12 months.

Mitigation measures, such as replacing valuable habitat, will be required to replace or augment any damage incurred with armoring. The extent of replacement or augmentation is not currently known; it is estimated that this could take up to two years. In order to mitigate damage caused by armoring, the creation of pocket beaches, mudflats and vegetated shallows will be evaluated. Sloping and/or cutbacks may be used and shoreline irregularity can be designed to support future mitigation of the marine biota. Mitigation may occur at the Asarco Site or another location off the Asarco property.

(6) Implementability

Treatment of source area soils using a solidification/stabilization method is implementable. With the exception of the following practical limitations, excavation of source area soils is implementable. Some of the practical limitations on excavating soil from the source areas include:

(a) Natural features. In the arsenic kitchen area soil excavation will be limited due to the presence of a silt aquitard that is beneath the soils. The aquitard acts as a natural protective barrier preventing metals from moving into the deepest groundwater aquifer on the site. EPA believes that it would be detrimental to the lower aquifer to excavate some or all of this protective silt barrier even though the upper portions of it may contain metals with elevated concentrations of contaminants.

(b) Man-made features. It is estimated that 15 million tons, or approximately 40 acres, of slag make up the plant area and the slag peninsula. Previous plant site investigations show that slag contains up to 25,000 parts per million arsenic, copper and lead. Excavation of all of this slag is not practicable, however, because of its large volume, the potential for fractured slag to reach the bay during excavation, and the cost to dispose this volume of material.

The copper refinery and the fine ore bins areas include both contaminated soil and slag. If, after soil removal, these areas continue to act as significant sources of groundwater contamination, EPA will evaluate whether further excavation of slag is necessary.

In the southeast plant area, the combination of organic constituents such as DMA and buried sawdust appear to enhance the mobility of metals in slag, resulting in high concentrations of metals in ground water. The sawdust, however, is buried 25 to 30 feet in slag and under saturated, highly permeable conditions adjacent to the shoreline. Excavation through the slag to remove the sawdust at these depths is not technically practicable.

Otherwise, soils in the arsenic kitchen, stack hill, cooling pond, copper refinery and fine ore bins area can be removed with conventional excavation techniques. Diversion trenches and other techniques to dewater source area soils prior to excavation would need to be used and are implementable when carefully designed and constructed. Treatment or disposal of contaminated water resulting from dewatering is implementable.

OCF

An OCF can be built in either the parking lot or arsenic kitchen areas of the Site. One concern regarding implementability is whether the OCF will have sufficient capacity for on-site soils and debris. Adding some capacity to the bermed structure in the parking lot and to the circular earth berm in the arsenic kitchen area prior to completion of the structure may be possible by increasing its height. However, the ability to "add" height is limited by the need for structural stability and by future uses of the Site. Capacity could also be added to the linear design. Capacity could not be added once the circular concrete tank is constructed.

Off-site disposal would probably require the construction of a staging area. Currently there is no railroad access to the site and trucks would have to be used to transport excavated soils and demolition debris to the staging area.

Capping the Site

Capping with either low permeability asphalt or soil is possible. For either type of cap it would be necessary to regrade the site and assure that several drainage and ponding areas on the site are eliminated. In general, capping would use common conventional construction techniques that have been proven reliable. Maintenance would be required for both types of caps but would be more intensive for the asphalt cap and would require annual crack sealing and seal coats.

Both caps would require guidelines to minimize overall disturbances after they are installed.

Portions of either type of cap would need to be removed if future cleanup activities are necessary (e.g., installing a ground-water pump and treat system).

Surface Water. Repair or replacement of the existing surface water drainage system is feasible but must be coordinated with soil excavation and capping activities. Conducting repair/ replacement activities prior to placing the cap would not be difficult to implement. Once a cap is in place, maintenance, repair or replacement of the existing drainage system or the slip-lined system would be the most difficult since it would require breaking through the cap.

Sliplining most pipes in the current drainage system is technically feasible for most, but not all, of the drain pipes. Also, in order to find and access some of the drainage pipes for slip-lining, it may be necessary to excavate some of the slag. In general, slag excavation is more difficult than removing soil and newly fractured pieces of slag tend to be more leachable in surface and ground water. Over the long-term, it would be most practicable to build a new drainage system for several reasons: (1) blueprints of the new system would be available to future workers, owners, etc.; (2) a new drainage system can be constructed within the cap thus workers would not be exposed to contaminated soils beneath the cap when making repairs; and (3) the protective clay layer of the cap would probably not need to be breached if repairs or replacement of new drainage pipes are necessary. Property access from adjacent land owners for installation of some parts of a new system would be necessary.

Diversion of surface water run-on is also technically feasible. Property access for installation of the surface water diversion system from adjacent land-owners, the Town of Ruston and the City of Tacoma would be necessary and is believed possible. In addition, the City would have to verify that there was sufficient capacity at the City and/or Edwards Street outfalls to accept the diverted surface water.

Demolition. Building demolition and dust suppression are technically and administratively implementable because they employ conventional trade methods.

Ground Water. Groundwater monitoring is possible and has been conducted on this Site for many years. Bi-annual monitoring is currently being performed. Quarterly monitoring would begin as soon as soil excavation is complete and before a cap is installed.

Shoreline Armoring. See discussion above under "long-term effectiveness and permanence."

(7) Cost

EPA has grouped Asarco's cost estimates into two major categories. The first group contains these elements of the cleanup that EPA believes are essential under any acceptable cleanup alternative. The total cost of these "essential elements" is $22.5 million. The estimated costs of essential elements and the disposal alternatives are shown in Table 8-2.

(8) State Acceptance

The State of Washington concurs with the selected remedy and phased approach described in this ROD for the former Asarco Tacoma Smelter Facility. The combination of measures to excavate and consolidate the more highly contaminated soils and debris in a containment facility with a design equivalent to federal hazardous waste disposal standards, to cap the entire Site, and to provide certain Site restrictions is appropriate and protective against exposure to such soils. This current ROD provides for measures to divert surface waters from contact with contaminants, however, the, ROD also provides that additional remedial measures may be taken on surface water should such further measures be necessary. Ground water will be addressed in a separate, second phase ROD which will be prepared after the impacts of the soils actions and water diversion measures under this ROD have been evaluated. This approach and selected remedy are deemed to be in compliance with the environmental laws and regulations of the State.

(9) Community Acceptance

EPA held a 90-day public comment period on the cleanup activities for the Site. It received approximately 900 comments either directly, or through Asarco or the Tacoma City Club. In addition, EPA has considered public comments in developing its selected remedy by tracking the land use planning strategy and through contacts with and input from the public. Much of the public interest appears to be focused on what to do with the Asarco Site after the cleanup, however, there were many specific comments on the elements of EPA's Preferred Alternative.

EPA believes that its selected remedy will be acceptable to the community based on the public comment received and their continued involvement in implementation of this cleanup.

To date, the most debated public issue regarding the cleanup itself has been whether to dispose contaminated soil and other materials in an OCF. Many members of the community, including the elected leaders and local business leaders, expressed support for an OCF. It appears that most of the support for on-site disposal was a result of Asarco's promise, in the "Agreement in Principle," with Ruston, Tacoma, and the Park District, to fund an estimated $15-20 million of future development activities on the Site.

Although the OCF provision in the Agreement in Principle is not binding on EPA, the overwhelming community support for an OCF is a significant factor in EPA's final remedy selection. Several commenters who generally supported an OCF suggested design modifications for the disposal facility such as treating soil before disposal, constructing separate cells within the unit for more precise monitoring and segregated disposal of soil (see Section 7.2 for EPA's responses to these comments). In addition, several commenters encouraged EPA to select the remedy that would be the most protective of human health and the environment over the long-term and not be influenced by Asarco's promise of future development. Based on EPA's belief that an OCF can be designed to be protective over the long-term and the overwhelming community support, EPA has significantly modified this component of its Preferred Alternative and selected disposal in an OCF rather than treatment.

EPA has received other significant comments on its proposed approach to cleanup the Site. Several natural resource trustee agencies and environmental groups have actively participated in EPA's technical meetings on cleanup and have submitted written comments. They have stated that EPA needs to develop an environmentally sound cleanup for the Site that ends current chemical contamination and that is not compromised or undermined by potential future land uses. EPA believes that its cleanup meets those objectives and that it will be important for these groups and local citizens to continue be involved with the review of the remedial design plans for this Site.

In addition, the Department of Natural Resources, the U.S. Fish and Wildlife Department, Citizens for a Healthy Bay and Asarco raised questions regarding the need for armoring the slag based on the amount of slag erosion and the design of shoreline armoring. Although it is visually apparent that slag is eroding, EPA agrees with the commenters that the extent and location of erosion should be determined first (e.g., using durability tests). After this step, EPA has determined that additional design studies will be conducted to determine the location and extent of armoring, including cutbacks or excavation in order to anchor the base of the armoring.

EPA also received many comments that encouraged site cleanup to progress as quickly as possible. Therefore, EPA has decided that if the Site is ready to be capped, but all of the Ruston/North Tacoma residential soils have not been removed from the Study Area, the Site will be capped and an appropriate off-site disposal facility will be selected for these soils as per Ecology's dangerous waste exemption.

TABLE 8-2. COST

Essential Elements:

Activity	Capital Cost	Operation & Maintenance (annual)	Present Worth
Plant Site Soils:			
Capping the Site			
Smelter	$6.4 m	$6,000	$6.5 m
Slag Peninsula	$923,000	$5,800	$1 m
Demolish fine ore bins building	$1.4 m	$0	$1.4 m
Interception trenches (for dewatering and diverting ground water)	$710,000	$0	$710,000
Surface Water:			
Replace drainage system with new drainage system	$1.4 m	$7,200	$1.5 m
Shoreline Armoring:			
Shoreline armoring (riprap)			
Smelter	$3.4 m	$12,000	$3.6 m
Slag Peninsula	$2.5 m	$11,000	$2.6 m
Ground Water and Marine Sediments:			
Abandon production well	$9,750	$0	$9,790
Monitoring of ground water and sediments	$650,000	$263,000	$4.7 m

Plant Site Soils
(Excavation/Treatment/Disposal

Activity	Capital Cost	Operation & Maintenance (annual)	Present Worth
(a) Excavation and treatment of soil and materials from source areas; treated soil put back below Site cap	$38.2 m	$0	$38.2 m*
And			
(b) Off-site disposal of debris	$12.7 m*	$0	$12.7
SUBTOTAL			$50.9

* Please note that Asarco recently revised its estimated cost of on-site treatment ($38.2 million) from the estimate that was used for Alternative PSS-4A in Section (F) above ($48.2 million).

Activity	Capital Cost	Operation & Maintenance (annual)	Present Worth
Or			
(c) Excavation and disposal of soil and debris in RCRA OCF (no treatment)	$22.6 m	$12,000	$22.8 m
Or			
(d) Excavation and treatment of soil and disposal of treated soil and debris in on-site hazardous waste landfill	$65.3 m	$12,000	$65.5 m
Or			

Other Elements:

Institutional controls
$500,000 .... $0 .... $500,000

Essential Elements Total .... $22.5 m

(e) Excavation and treatment of soil and disposal of treated soil in on-site solid waste landfill, debris in off-site hazardous waste landfill
$70 m .... $12,000 .... $70.2 m

Or

(f) Excavation, and off-site treatment and disposal of soil and debris
$75.1 m.......... $0 .... $75.1 m

Essential Elements		Excavation/Treatment/Disposal		TOTAL Cleanup Costs
$22.5 million		(a) plus (b) $50.9 million		$73.4 million
$22.5 million		(c) $22.8 million		$45.3 million
$22.5 million	+	(d) $65.5 million	=	$88 million
$22.5 million		(e) $70.2 million		$92.7 million
$22.5 million		(f) $75.1 million		$97.6 million

*This amount includes an estimated cost of $200,000 to fill the tunnel. Removing the tunnel is estimated to cost $2.2 million. The decision whether to remove or fill will be made during remedial design.

9.0 THE SELECTED REMEDY

EPA's selected remedy combines elements from several of the media-specific alternatives described above. The selected remedy meets the requirements of the two mandatory threshold criteria, protection of human health and the environment and compliance with ARARs, and provides the best balance of benefits and trade-offs for the former Asarco Tacoma Smelter site.

Several proposed actions described in EPA's Preferred Alternative have either been initiated or completed since the public comment period. Ground water and sediments monitoring is underway (October 1994). In addition, EPA has allowed Asarco to abandon the production well (December 1994).

The following are the individual components of EPA's Selected Remedy.

9.1 PLANT SITE SOILS

9.1.1 Excavate Soil and Granular Slag From Five Source Areas [9]

Contaminated soil that fails the TCLP test in the stack hill, cooling pond and arsenic kitchen areas and contaminated soil and granular slag from the copper refinery and fine ore bins building areas will be excavated to the extent feasible. The party (EPA or Asarco) conducting the cleanup will perform the following activities during soil excavation:

(a) Asarco will submit the additional soil borings data required under the AOC (October 1994) to EPA during remedial design.

(b) Use interception trenches, or other applicable technology, to divert ground water where necessary to allow for easier excavation of soils.

(c) Control soil erosion and contaminated stormwater runoff by using best management practices (for example, sediment ponds, silt fences, diversion ditches, cut and fill slopes).

(d) Confirm that all necessary excavation has been performed.

(e) Remove or fill the car tunnel to allow for future land use plans. Whether the railroad tunnel will remain will be determined after discussions with Burlington Northern railroad.

(f) Conduct a wetlands assessment at the Site.

(g) Use capping material (see Section 9.1.3) to fill and regrade the excavated areas.

9 Excavation of the sixth source area, the southeast plant area, is impracticable (see "Implementability" in Section 8.0 above.)

9.1.2 On-Site Disposal

(a) Construct an OCF northeast of the arsenic kitchen area. The OCF will be an approximately 600-foot diameter circular earth berm with an estimated capacity of 240,000 cubic yards. The liner, cap, leak detection, collection and removal system, leachate collection and removal system and surface run-on and run-off system will meet federal and state standards for a hazardous waste landfill, see performance standards in Section 9.9.

(b) Construct surface water and groundwater diversion controls (for example, interception trenches and grout wall) around the OCF to prevent surface water and ground water from coming into contact with the OCF.

(c) Dispose the soils excavated from the source areas, the bricks temporarily stored on the stack hill, and the hazardous waste materials temporarily stored in the fine ore bins building in the OCF. Materials that are not on-site as of the date of this ROD will not be disposed in the OCF.

(d) Crush or shred over-sized debris prior to disposal.

(e) Conduct the appropriate seismic studies in order to construct the OCF to withstand earthquakes and landslides to the extent practicable.

(f) Monitor air quality to ensure that dust is not generated when soil and debris are excavated and disposed in the OCF (see other "safety measures" below).

(g) Do not dispose wet materials, including marine sediments, in the OCF.

(h) In the design plans for the OCF, allow for a limited amount of additional capacity in the event more than the estimated 160,000 cubic yards of soil or 80,000 cubic yards of demolition debris require disposal. In the event the amount of waste to be disposed is greater than the maximum capacity of the OCF, this material will be disposed off-site in an appropriate facility.

(i) Develop a plan for the closure of Ruston Way adjacent to the Site when construction of the OCF occurs.

(j) Maintain the OCF in perpetuity.

9.1.3 Capping the Site (PSS and slag and the slag peninsula)

After excavation of materials from the source areas, cap the entire Site (with the exception of the OCF and the possible exception of the Stack Hill area, see performance standards below) with, from bottom to top, soil excavated during the residential Study Area cleanup, a low permeability clay liner, a gravel drainage layer, at least 12 inches of clean topsoil (i.e., below MTCA residential cleanup levels), and sod, see Figure 7-1. The cap will meet the performance standards identified in Section 9.9. Capping of the Site includes the following elements:

(a) Grade and prepare the Site for capping, including grading the ramp constructed from Thorne Road slag. Use contaminated residential soils as a sub-base for the cap only in areas of the Site where they will not come into contact with ground water, for example, the slag portions of the Site. Stockpile contaminated residential soils on-site until they are ready to be used for capping.

(b) If the Site is ready to be capped, but not all of the residential soils have been excavated from the Ruston/North Tacoma Study Area, an appropriate off-site disposal facility (see Ecology's dangerous waste exemption dated December 20, 1993) will be selected. Whether a temporary staging area, on- or off-site, will be necessary will be determined during remedial design.

(c) Assure that existing asphalt and building pads on the site will not cause pooling and standing water beneath the cap. Eliminate pooling of surface water on the surface of the cap.

(d) Incorporate planning for future development, such as site grading, utilities, surface water drainage systems, landscaping and terracing, into design and construction of the cap to the extent possible.

(e) Fence and plant low lying shrubs in areas determined to be too steep to cap (e.g., the east and west gully slopes of the stack hill). Apply a geotextile material to the soil to provide erosion protection, as well as a means for supporting vegetative development.

(f) Perform mitigation activities if wetlands or aquatic ecosystems are adversely impacted by soil removal or capping. Evaluate the feasibility of setting aside areas on the slag peninsula to allow marine birds to feed and roost.

(g) Maintain the cap.

9.2 DEMOLISH REMAINING BUILDINGS AND STRUCTURES

Demolish all of the remaining buildings and structures on the smelter site. The sequence of building demolition and construction of the OCF will be determined during remedial design.

(a) Prior to demolition, inspect all remaining buildings and structures to locate and identify all asbestos-containing material (ACM). Remove ACM from the on-site buildings and dispose of it off-site in accordance with applicable federal and state requirements.

(b) Vacuum and wash buildings and structures at the Site before beginning demolition activities. Wash areas of structures containing dust that are inaccessible for vacuuming to curtail dust emissions. Collect wastewaters generated from the dust suppression system at each demolition site and route to a wastewater evaporation system, or dispose in an appropriate manner.

(c) Reactivate the air monitoring stations which were used during previous demolition activities (e.g., Site Stabilization-Phase 2).

(d) Use conventional trade demolition techniques for the demolition of, or dismantling of the remaining on-site structures. Use conventional equipment, such as shears, grapples, loaders, and cranes, where necessary to safely and efficiently dismantle the structures.

(e) Sample all debris from demolition of remaining buildings before disposal. Dispose any material other than wood waste that is determined to be hazardous waste using the TCLP test (e.g., steel, concrete, metal) in the OCF. Dispose debris that is not hazardous waste, but fails the wipe test, either off-site pursuant to a dangerous waste exemption issued by Ecology dated May 23, 1994, or in the OCF. Where appropriate, pressure wash debris. Recycle metal materials that pass both TCLP and the wipe test. Dispose all wood debris in an appropriate off-site disposal facility.

9.3 SURFACE WATER

(a) Plug and abandon or remove the entire existing surface water drainage system and install a new drainage system, including outfalls, in the smelter site cap to collect or divert water that runs onto the Site from the off-site drainage basins and from precipitation that originates on the site. In addition, ensure that seeps on the stack hill and other areas of the Site do not run on the Site.

(b) Monitor surface water quality during and after implementation of repair and replacement of the drainage system, soil removal, and capping. If surface water quality continues to exceed federal and state standards, treatment of surface water will be evaluated.

(c) Maintain the surface water drainage system.

9.4 SHORELINE ARMORING

Shoreline armoring of the plant site and slag peninsula, see Figure 7-3.

(a) Determine the extent of shoreline erosion by performing durability tests on the slag (e.g., specific gravity, absorption, accelerated expansion, abrasion tests, freeze/thaw test) and visual observation.

(b) Determine where shoreline armoring should be placed based on erosion tests.

(c) Anchor armoring on the slag face on the bayward side of the slag face along the plant site and slag peninsula, as appropriate, to prevent erosion of the slag due to currents, waves and tidal action. The interior portion of the Yacht Club basin will not require armoring.

(d) Remove abandoned structures, debris and waste (treated pilings, cables) near the shoreline along the slag peninsula as necessary.

(e) Mitigate or compensate for shoreline armoring activities that may result in adverse impacts to intertidal habitat. Identify and analyze potential mitigation measures following the guidelines under the Clean Water Act and the state's hydraulic code rules. EPA will work during the design phase of the cleanup with the federal and state trustees of natural resources to develop a mitigation plan.

Required mitigation measures to remedy the impact to the marine environment from shoreline armoring may include shoreline pull back and sloping, development of pocket beaches, mudflats, vegetated shallows, and shoreline irregularity, and may occur on-site or off the Asarco property.

(f) Maintain the shoreline armoring.

9.5 GROUND WATER AND MARINE SEDIMENTS

(a) Continue monitoring surface water and ground water and sampling marine sediments. Future sampling programs may include further monitoring of marine sediments to evaluate whether discharges from the Site after this cleanup are continuing to contaminate the sediments. Remedial measures to address offshore sediments will be included in a separate ROD.

(b) To control contaminants from entering the deeper ground water, EPA directed Asarco in December 1994 to "abandon" the production well, a deep well in the central area of the site that supplied water for smelter activities. Abandoning the well involved making small holes in and filling the well casing (the walls of the well) with grout, a concrete-like material.

9.6 OTHER ELEMENTS OF THE SELECTED REMEDY

9.6.1 Safety Measures

During cleanup, safety measures include, at a minimum, air monitoring with Hi-vol and PM10 air particulate monitors, using dust suppression techniques during excavation and disposal activities, lining and covering truck beds when transporting contaminated materials on public roads, removing soils from truck wheels before they travel on public roads (for example, from the stack hill area to the lower Site), developing a transportation plan to establish local truck routes to minimize disruption to the community, and temporarily storing hazardous waste on-site in compliance with waste pile requirements.

9.6.2 Integrating Cleanup With Land Use Plans

Develop an enforceable program of restrictions and guidelines to supplement the actual cleanup activities. Such measures are necessary to ensure that development activities do not affect the long-term effectiveness of the cleanup and will include, but are not limited to the following:

(a) Establish a maintenance and monitoring program to ensure the continued integrity of the low-permeability soil cap, the OCF and shoreline armoring.

(b) Establish guidelines to ensure that future cleanup measures (including, if necessary, remediation of ground water and/or surface water) will not be prevented or hindered by development activities.

(c) Establish guidelines for conducting construction and maintenance activities to ensure that little or no remaining contamination is exposed or released during future (post-cleanup) excavation. Develop additional guidelines to identify the appropriate actions if contaminant exposure or release occurs (e.g., Asarco's responsibility for disposal of contaminated soil). Activities addressed by these procedures will include installation of underground utilities, basements or elevator shafts and roadways.

(d) Use deed restrictions to prohibit the use of ground water at the Site and to ensure compliance with the program and guidelines described in (a), (b), and (c) above.

(e) Develop public educational materials and markers or signs for future users and occupiers of the Site. The materials and markers or signs will describe the cleanup and explain what the users and occupiers should and should not to maintain the effectiveness of the cleanup.

9.6.3 Periodic Review

The protectiveness of the cleanup will be reviewed at least every five years.

9.7 CLEANUP SCHEDULE

EPA estimates that the selected remedy will take five years to complete. It is possible that soil removal and/or capping in one area of the Site (for example, the stack hill or parking lot) can be completed so that development activities can start prior to completion of the cleanup of the entire Site.

EPA will not allow development to begin in any area, however, until it determines that cleanup in that area is complete, that development is safe given cleanup activities taking place elsewhere on-site, and that development would not interfere with potential cleanup measures in the future.

9.8 COST OF THE SELECTED REMEDY

EPA estimates that the cost to perform the Selected Remedy will be $45.3 million. These costs are estimated and are considered to be accurate to within -30% to +50%. Costs are described using the present worth methodology with a discount rate equal to five percent. The cost estimate includes direct and indirect capital costs, as well as annual operations and maintenance costs. Operation and maintenance (O & M) costs have been estimated for 30 years but O & M activities will be required in perpetuity. See Section 8(7) and Table 8-2 for a more complete breakdown of costs.

9.9 PERFORMANCE STANDARDS

The final Site cleanup levels will be adjusted so that the overall cancer risk from all of the media and the exposure pathways will be equal to or less than 1 x 10-5 and the non-cancer effects will be equal to or less than 1.0

PLANT SITE SOILS

In order to obtain the Cleanup Objectives described in Section 6.7, performance standards and/or remediation goals have been established for each medium that will be cleaned up.

Source Areas. The boundaries of the source areas that require excavation generally will be defined by soils that exceed hazardous waste levels as determined by the TCLP test, see below, and by practical limits on excavation, see Section 8 - Implementability. If soils outside the source areas exceed hazardous waste levels, EPA will evaluate whether further excavation is warranted. These numbers do not represent remediation goals but rather serve as markers for areas to be excavated. Because all areas of the Site will be addressed by soil/slag removal, the OCF, or the Site cap, specific remediation goals for PSS have not been selected.

Chemical	mg/L
Arsenic	5.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0

The entire site, excavated source and non-source areas, will be capped. The cap will meet the requirements described herein. If, however, after excavation, soil in the. stack hill area is below levels comparable to the action levels set for the Ruston/North Tacoma cleanup, a less stringent cap using only soil and a vegetative cover will be required. "Comparable" levels will be determined by EPA and Ecology.

Cover System

A low hydraulic conductivity layer including a minimum of one (1) feet of compacted soil over the soil and slag with a maximum hydraulic conductivity of 1 X 10-7 cm/sec, which is to be designed, constructed, operated and maintained to maximize removal of water by the overlying drainage layer and to minimize infiltration of water into the contaminated soil, and slag.

A drainage layer of at least .5 feet or greater granular drainage materials with a hydraulic conductivity of 1 X 10-2 cm/sec or equivalent. The drainage layer, which is placed above the low hydraulic conductivity layer, must be designed to minimize the amount and residence time of water coming into contact with the low hydraulic conductivity layer, thereby decreasing the potential for leachate generation.

A top cover comprised of two (2) layers. The top component is vegetation designed to impede erosion while still allowing surface runoff from major storm events. The lower component is a minimum of one (1) foot of soil capable of sustaining plant species that will minimize erosion.

The cover system must be designed and constructed to meet the following performance standards:

(a) Prevent direct contact of people, animals, and surface water with contaminated soils and slag.

(b) Prevent contaminated soil from being wind-blown.

(c) Provide long-term minimization of migration of liquids through the Asarco Smelter site.

(d) Function with minimum maintenance.

(e) Promote drainage and minimize erosion or abrasion of the cover.

(f) Accommodate settling and subsidence so that the cover's integrity is maintained.

(g) A construction quality assurance (CQA) program shall be established for the cover system to ensure that the constructed cover meets or exceeds all design criteria and specifications.

Modifications of the cover system in areas where development will occur will need to be approved by EPA on a case-by-case basis.

Post Closure Care

Maintain the integrity and effectiveness of the final cover, including periodic inspections and making repairs to the soil cap as necessary to correct the effects of settling, subsidence, erosion, or other events.

Prevent run-on and run-off from eroding or otherwise damaging the final cover.

CONTAINMENT FACILITY

The following performance standards are based on requirements in 40 C.F.R. Part 264 for hazardous waste landfills.[10]

[10] Specific references to federal regulations only are set forth in this section. The requirements of this section are intended to also comply with state requirements for landfills set forth in WAC 173-303-665.

Bottom Liner System (40 CFR Sections 264.301(c)(i), 264.301(a))(1)(i), (ii), and (iii))

A composite top liner including a minimum of one (1) foot of compacted soil with a maximum hydraulic conductivity of 1 X 10-7 cm/sec overlain by a flexible membrane liner.

A composite bottom liner including a minimum of three (3) feet of compacted soil with a maximum hydraulic conductivity of 1 X 10-7 cm/sec overlain by a flexible membrane liner designed to prevent the migration of hazardous constituents into the upper components.

The upper component of the top and bottom composite liner will be designed and constructed to prevent migration of hazardous constituents into this component during the active life and post-closure period. The lower component of the top and bottom composite liner will be designed and constructed to minimize the migration of hazardous contents if a breach in the upper component were to occur.

The liner system shall be designed and constructed to comply with 40 CFR Sections 264.301 (a)(1)(i), (ii), and (iii) to assure that it is engineered to withstand the chemical and physical stresses it will be subjected to while containing the waste. The liner system shall be located, designed, constructed, and operated to be completely above the seasonal high water table.

Leachate Collection and Removal System (40 CFR Sections 264.301(c)(2)) and

264.301(c)(3) and (iv))

The leachate collection and removal system immediately above the top liner must be designed, constructed, operated, and maintained to collect and remove leachate from the landfill during the active life and post-closure care period. It shall be designed and operated to ensure. that leachate depth over the liner does not exceed one (1) foot.

The leachate collection and removal system immediately above the top liner shall be designed and constructed to comply with 40 CFR Sections 264.301 (c)(3) (iii) and (iv) to assure that it is engineered to withstand the chemical and physical stresses it will be subjected to and to minimize clogging.

Whether leachate will be treated and discharged on-site or disposed off-site will be determined during remedial design.

Leak Detection Collection and Removal System (40 CFR Sections 264.301(c)(3)(i-v), 264.301 (0)(4), 264.302, and 264.304).

The leak detection, collection and removal system in between the liners shall be constructed with a bottom slope of one percent or more of granular drainage materials with a hydraulic conductivity of 1 X 10-2 cm/sec and a thickness of 12 inches or more, or with synthetic or geonet drainage materials with a transmissivity of 3 X 10-5 m2/sec or more and it shall be constructed with sumps and liquid removal methods that shall be operated to minimize the head on the bottom liner system in accordance with 40 CFR Sections 264.301 (c)(3)(v) and 264.301 (c)(4). An action leakage rate and response action plan will be established for the. OCF in accordance with 40 CFR Sections 264.302 and 264.304 to address design flow rates in the leak detection system which will result in a head greater than a foot on the bottom liner system.

The leak detection, collection and removal system in between the liners shall be designed and constructed to comply with 40 CFR Sections 264.301 (c)(3)(iii) and (iv) to assure that it is engineered to withstand the chemical and physical stresses it will be subjected to and to minimize clogging.

Surface Run-on Control System (40 CFR Sections 264.301 (g) and (i))

Design, construct, operate and maintain a run-on control system capable of preventing flow onto the active portion of the landfill during peak discharge from at least a 25-year storm. Collection and holding facilities which are associated with this system must be emptied expeditiously after storms to maintain design capacity of the system.

Surface Run-off Control System (40 CFR Sections 264.301 (h) and (i))

Design, construct, operate, and maintain a run-off management system to collect and control at least the water volume resulting from a 24 hour, 25-year storm. Collection and holding facilities which are associated with this system must be emptied expeditiously after storms to maintain design capacity of the system. Discharges to Commencement Bay shall comply with surface water performance standards.

Control of Particulate (40 CFR Section 264.301 (j))

The OCF shall be operated to control wind dispersal of contaminated soil, slag and debris placed in it.

Monitoring, Inspection, and Construction Quality Control (4O CFR Sections 264.303, and 264.19)

A CQA program shall be established for the OCF to ensure that the constructed unit meets or exceeds all design criteria and specifications in accordance with 40 CFR Sections 264.19 and 264.303. The landfill systems must be inspected during operation and the leak detection system after closure. Inspection of the landfill during operations will be in accordance with 40 CFR Section 264.303.

Cover System (40 CFR Sections 264.310 and 264.19)

A composite low hydraulic conductivity layer including a minimum of two (2) feet of compacted soil over the waste with a maximum hydraulic conductivity of 1 X 10-7 cm/sec overlain by a flexible membrane liner designed, constructed, operated and maintained to maximize removal of water by the overlying drainage layer and to minimize infiltration of water into the contaminated soil, slag and debris in the OCF.

A drainage layer of one (1) foot or greater granular drainage materials with a hydraulic conductivity of 1 X 10-2 cm/sec and a thickness of 12 inches or more, or with synthetic geonet drainage materials with a transmissivity of 3 X 10-5 m2/sec or more overlain by filter layer to prevent clogging of the drainage layer. The drainage layer, which is placed above the composite low hydraulic conductivity layer, must be designed to minimize the amount and residence time of water coming into contact with the composite low hydraulic conductivity layer, thereby decreasing the potential for leachate generation.

A top cover layer comprised of two (2) layers. The top component is vegetation designed to impede erosion, but allowing the surface runoff from major storm events. The lower component is a minimum of two (2) feet of soil capable of sustaining plant species that will minimize erosion.

The cover system must be designed and constructed to meet the following performance standards specified under 40 CFR Sections 264.111 and 264.310:

(a) Minimize the need for further maintenance.

(b) Control, minimize or eliminate, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.

(c) Provide long-term minimization of migration of liquids through the closed OCF.

(d) Function with minimum maintenance.

(e) Promote drainage and minimize erosion or abrasion of the cover.

(f) Accommodate settling and subsidence so that the cover's integrity is maintained.

(g) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

(h) A CQA program shall be established for the OCF cover system to ensure that the constructed cover meets or exceeds all design criteria and specifications in accordance with 40 CFR Section 264.19.

Closure Certification and Post Closure Care of the OCF (40 CFR Sections 264.310, 264.115, 264.116, 264.117, 264.118, 264.119, and 264.120)

The closure certification, monitoring, operation, maintenance and record keeping requirements of 40 CFR Sections 264.310, 264.115, 264.116, 264.117, and 264.118 must be adhered to after closure of the OCF. The post-closure period for the OCF shall be indefinite.

DEMOLITION/EXCAVATION/DISPOSAL

(a) Air. Hi-vol and PM10 air particulate monitors will be used to confirm that the following levels are not exceeded.

Chemical	mg/L**11**
Arsenic	02
Lead	0.75
PM10	75

(b) Dust Control. A "no-visible dust" standard will be in effect.

11 The arsenic levee is based on 5 x 10-5 risk-based levels over a 10 year period The lead level is based on ½ the allowable PSAPCA level. PM10 levels are based on half of the quarterly allowable 24-hour allowance.

SURFACE WATER

The remedial goals identified for surface water in EPA's September 1993 document entitled, "EPA's Preliminary Remedial Action Objectives," (Table 9-1) are the performance standards that surface water discharging into Commencement Bay must meet. Whether a mixing zone for point source discharges is necessary will be determined during remedial design.

Shoreline Armoring

Minimize the release of slag particles into the bay.

Ground Water

The preliminary remediation goals for Class III ground water impacting surface water (water that is not suitable for drinking) (Table 9-2) will be used as a benchmark to determine the effectiveness of source control activities. Final groundwater remediation goals will be selected in a final ROD for ground water.

TABLE 9-1. REMEDIATION GOALS FOR SURFACE WATER IMPACTING PUGET SOUND

CONTAMINANT	REMEDIATION GOAL (µ/L)	REFERENCE
Arsenic	2.0	MTCA B, PQL[a] based on the CRDL[b]
Beryllium	1.0	MTCA B, CRDL
Cadmium	8.0	MTCA B, WQS for aquatic life
Chromium VI	50	MTCA B, WQC/WQS for aquatic life
Copper	10.0	MTCA B, PQL based on EPA Method 1220.2 which has an IDL of 1.0 to 2.0
Lead	5.8	MTCA B, WQS
Mercury	0.2	MTCA B, PQL based on CRDL
Nickel	7.9	MTCA B, WQS
Selenium	71	MTCA B, WQC/WQS for aquatic life
Silver	1.2	MTCA B, WQS
Zinc	76.6	MTCA B, WQS
Total Petroleum Hydrocarbons	10,000.0	MTCA B, Ecology's Guideline for Discharges Containing Oil and Grease of Mineral Origin
Aniline	1.3-37	Preliminary criteria for the protection of aquatic life
4-Chloroaniline	29-61	Preliminary criteria for the protection of aquatic life
N-Methylaniline	160	MTCA B, risk-based
N-Nitrosodi-phenylamine	10	MTCA B, PQL based on CRDL

a Practical Quantitation Limit

b Contract Required Detection Level

NOTE: If use of a mixing zone is appropriate, the compliance point for the surface water discharge would be at the edge of the designated mixing zone in Puget Sound. These values have not been adjusted to take into account the background levels of these contaminants in uncontaminated surface water on land or in surface water in Puget Sound.

TABLE 9-2. PRELIMINARY REMEDIATION GOALS FOR CLASS III GROUND WATER IMPACTING SURFACE WATER IN PUGET SOUND

CONTAMINANT	EPA REMEDIATION GOAL (µ/L)	REFERENCE
Arsenic	6	MTCA B, background [MTCA B number (106 risk) for fish consumption is 0.14
Beryllium	1.0	MTCA B, PQL based on CRDL [MTCA B number (10-6 risk) for fish consumption is 0.08
Cadmium	8.0	MTCA B, Water Quality Standards (WQS) for aquatic life
Chromium VI	50	MTCA B, Water Quality Criteria (WQC)/WQS for aquatic life
Copper	40	MTCA B, background (WQS is 2.5)
Lead	12	MTCA B, background (WQS is 5.8)
Mercury	0.2	MTCA B, PQL based on CRDL (WQS/WQC are 0.025)
Nickel	0.2	MTCA B, background (WQS is 7.9)
Selenium	71	MTCA B, WQC/WQS for aquatic life
Silver	1.2	MTCA B, WQS for aquatic life
Zinc	98	MTCA B, background (WQS is 76.6)
Total Petroleum Hydrocarbons	10,000.0	MTCA B ARAR, Ecology Guideline for Discharges Containing Oil and Grease of Mineral Origin (using TPH analysis)
Aniline	1.3-37	Preliminary criteria for the protection of aquatic life
4-Chloroaniline	29-61	Preliminary criteria for the protection of aquatic life
N-Methylaniline	160	MTCA B, risk-based (10-6)
N-Nitroso-diphenylamine	10	MTCA B, PQL based on CRDL [MTCA B number (10-6 risk) for fish consumption is 6.1

10.0 STATUTORY DETERMINATIONS

10.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy will eliminate, reduce, or control exposure to contaminants on the Site at the former Asarco Smelter facility. Risks from exposure to soil, slag, and surface water will be eliminated by removing and isolating source area soils, capping contaminated soil and slag, demolishing the remaining buildings, replacing the existing drainage system with a new drainage system and armoring portions of the shoreline.

An enforceable program consisting of legal, engineering and administrative restrictions and guidelines will also be developed to supplement the actual cleanup activities. This program is required in order to assure that the cleanup activities remain protective (e.g., cap, armoring and OCF maintenance), to prohibit certain activities (e.g., drinking ground water), and to address the residual risk of the contaminants left on site.

Accordingly, the selected remedy is protective of human health and the environment.

10.2 COMPLIANCE WITH ARARs

The selected remedy will attain ARARs under federal and state law (see Table B-8 in Appendix B). Compliance with requirements for selection of cleanup actions under MTCA are discussed in Section 10.4 below. The interim measures waiver will be used for the state ARAR for restoring ground water. EPA will select a final remedial action for ground water that will attain the ARAR or provide a justification for its waiver.

10.3 COST-EFFECTIVENESS

The cost of the selected remedy is proportional to its overall effectiveness and it represents a reasonable value for the money to be spent. EPA made this determination by Comparing the cost and effectiveness of treating soil versus disposing untreated soil and debris in an OCF based on the significant community support for on-site disposal.

EPA believes that excavating soil from the source areas is the key step to reducing contaminant concentrations in ground water and surface water. How to dispose of the contaminated soil has been the most significant issue in this cleanup. Treating contaminated soil with a solidification/stabilization process will bind contaminants in a cement-like mixture (but will not detoxify or reduce concentrations). Contaminants in treated soil are unlikely to move out of the soil into other media. The treated soil can be used as sub-base for a site cap. The estimated cost of treating soil is $38.2 million. If soil treatment were selected, the estimated cost for off-site disposal of contaminated debris (which cannot be treated) is $12.7 million, for a cost of $50.9 million. **12**

12 The $50.9 million is in addition to the estimated cost of $22.5 million for the "essential elements" of the remedy (see Section 8.7 above).

Both soil and debris can be disposed in an OCF. The OCF option will attain a similar objective to treatment, which is minimizing the movement of contaminants into other media, by containing the contaminated soil in a large on-site landfill. The most significant technical difference between treatment and the OCF is that active measures, other than monitoring, would not have been necessary for the treated soil but a permanent operation and maintenance (O&M) program is required to maintain the integrity of the OCF. The O&M program will be a legally enforceable component of the cleanup. The estimated coat for disposal in an OCF is $22.8 million.

The difference in estimated costs between the treatment and OCF options is $28 million. EPA concludes that because the ability of the OCF to isolate contaminants from the environment is as effective as treating contaminated soil, and because of the strong community support/or on-site disposal, the OCF is a cost-effective solution.

It should be noted that the estimated cost to transport and dispose soil and debris in an off-site landfill is $75.1 million, over $50 million higher than the OCF option. Although off-site disposal would permanently avoid all potential problems associated with leaving contamination on-site, EPA believes that, in comparison, the OCF still represents the best value for the money. This determination is also based on the fact that significant contamination, e.g., 15 million tons of slag would remain at the Site even if contaminated soils from the source areas were disposed off-site. Off-site disposal does not mean that problems at the Site are eliminated.

EPA has determined that the other components of the selected remedy are also cost-effective because they represent a reasonable cleanup value for the money.

10.4 UTILIZATION OF PERMANENT SOLUTIONS, AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The NCP states that this requirement is fulfilled by selecting the alterative that is protective, complies with ARARs, and provides the best balance of trade-offs in terms of the five balancing criteria (numbers 3 through 7 in Section 8.0). The modifying criteria (numbers 8 and 9) shall also be considered. Under MTCA Section 173-340-360(5), very similar criteria are used to select permanent solutions to the maximum extent practicable and to select from among the hierarchy of cleanup technologies in 173-340-360(4).

Again, the crucial decision at this Site is how to manage soil excavated from the source areas and demolition debris. The alternatives range from treating soil to disposing soil and debris, without treatment, in an OCF, to disposing soil and debris off-site. EPA believes that each of these alternatives is protective and complies with ARARs. For the following reasons, EPA has determined that disposing soil and debris, without treatment, in an OCF provides the best balance of trade-offs considering the balancing and modifying criteria, (e.g., community acceptance).

The most important differences in the alternatives are with respect to long-term effectiveness, cost, and community acceptance. Treating soils with a solidification/stabilization technology appears to be effective in preventing the movement of contaminants out of soils into other media. Treatment will not destroy or reduce the toxicity of contaminants, thus requiring long-term monitoring to ensure that treatment remains effective. Treated soils might have been put back on the Site as sub-base for a cap but not in areas where construction is likely to occur, making it less accommodating of future uses than an OCF. The estimated cost of treatment is $38.2 million, plus $12.7 million for disposing debris that cannot be treated, for a total of 50.9 million. In addition, during the 90-day public comment period, approximately 830 out of 900 local residents, businesses and local officials supported an OCF and future development of the Site.

Disposing soil and debris in an off-site landfill would be the most effective solution for the Site over the long-term because the problems associated with on-site management of this soil and debris would be eliminated. It is, however, important to remember that regardless of which alternative is selected, an estimated 15 million tons of slag, which contains hazardous substances, and contaminated soil not within the source areas will remain at the Site because it is impracticable to remove and dispose it elsewhere. Although slag and non-source area soil currently contribute less than the source areas to groundwater contamination, these are still contaminated areas that cannot be left alone. Their contribution to groundwater contamination can further be reduced by capping these areas. Thus, even if EPA selected off-site disposal of soil and debris, long-term management of the contamination that remains on-site would still be an important component of EPA's cleanup. Off-site disposal, excluding management of remaining slag and soil on-site, is estimated to cost $75.1 million. In addition, 830 out of 900 commenters supported an OCF and future development of the Site.

The OCF option, which consolidates the most contaminated soil and debris in a landfill on-site, is an effective solution over the long-term if it is designed and constructed properly and continuous attention is paid to its operation and maintenance.**13** Its estimated cost of $22.8 million is significantly less than the $50.9 million for treatment and the $75.1 million for off-site disposal. Further, Asarco has demonstrated that the OCF can be constructed on-site so as not to interfere with plans for future development of the property. Comments from individuals and groups in the community overwhelmingly endorsed this approach because of their desire to see such development at the Site. Accordingly, because it is an effective method to isolate contaminants from the environment, costs significantly less than other options, and is most accommodating of future uses desired by the community, EPA has determined that the OCF option provides the best balance of tradeoffs and, therefore, is the permanent solution to the maximum extent practicable for cleanup of the Asarco Site. For the same reasons, under MTCA, selecting disposal in an engineered facility is appropriate even though immobilization of hazardous substances is more preferred in the regulations.

EPA has determined that other components of the selected remedy are also permanent to the maximum extent practicable.

13 EPA's analysis shows that treating soil before it is placed in an OCF does not provide significant benefits in terms of reducing contaminants moving into the environment should there be a structural failure of the OCF in the future. Therefore, this option has not been selected. See Section 7.2 and Appendix D.

10.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT.

As explained in Section 10.4 above, none of the components of the selected remedy will satisfy the preference for treatment. If treatment of surface water is necessary in the future, the preference for treatment would be satisfied.

11.0 DOCUMENTATION OF SIGNIFICANT CHANGES

In the Proposed Plan, EPA recommended treatment of contaminated source area soils because treated soils did not significantly leach above regulatory levels and EPA believed that the community and the elected officials were strongly opposed to an OCF based on meetings held in the community over the past several years. During the public comment period on the Proposed Plan, EPA received comments from the majority of the public and their elected representatives strongly encouraging the selection of an OCF in lieu of soil treatment (solidification/stabilization) and disposal.

The two approaches for these soils are comparable in terms of their overall protectiveness but differ primarily with respect to their cost and compatibility with future land use and community acceptance. For the reasons stated above, EPA's selected remedy provides for the on-site containment of excavated source area soils. Soils will not require treatment before disposal in the OCF.

In the Proposed Plan, EPA recommended that the slag shoreline along the Asarco Site and the slag peninsula be armored with riprap. During the public comment period, several commenters wondered whether the shoreline was eroding, whether the erosion was causing an adverse impact on the adjacent marine sediment and if more harm than good would be caused if by adversely impacting existing habitat which lived on the current slag face.

Several commenters questioned whether the slag shoreline was eroding, whether the eroded slag particles caused an adverse impact on the adjacent marine environment, and why the shoreline needed to be armored since it is already providing a suitable habitat for marine biota. If shoreline armoring was determined to be necessary, commenters also questioned how it would be anchored to the existing slag face and why riprap (large rocks) was selected instead of artificial beach nourishment (small rocks and sand) to armor the slag.

After evaluating the comments received and finding out that a shoreline monitoring station, consisting of large rocks piled against the shoreline was destroyed by tidal action and strong shoreline currents, EPA still believes that some amount of shoreline armoring will be necessary to prevent erosion of slag particles, which cause adverse effects to marine organisms in the Bay. However, EPA has determined that before the design of the shoreline armoring begins, additional data should be collected to determine (1) the extent of shoreline erosion; (2) how and where armoring should be placed; and (3) the impact of armoring to the existing marine biota versus the impact of not armoring slag to the marine biota over time. EPA will encourage other state and federal resource agencies and community groups to participate in the development of the shoreline armoring.

APPENDIX A
ASARCO
RECORD OF DECISION
RESPONSIVENESS SUMMARY

March 1995

U.S. Environmental Protection Agency
Region 10

TABLE OF CONTENTS

LIST OF ACRONYMS USED IN THIS DOCUMENT

AIP	Agreement in Principle
ANS	American Nuclear Society
ARARs	Applicable or Relevant and Appropriate Requirements
Asarco Site	The Former Asarco Smelter Site
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CHB	Citizens for a Healthy Bay
DNR	Washington State Department of Natural Resources
EPA	U.S. Environmental Protection Agency
MWEP	Municipal Waste Extraction Procedure
NPL	National Priorities List
OCF	On-Site Containment Facility
Park District	The Metropolitan Park District
ppm	parts per million
PRP	Potentially Responsible Party
Puyallup Tribe	The Puyallup Tribe of Indians
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
Ruston	Town of Ruston
SARA	Superfund Amendments and Reauthorization Act of 1986
Tacoma	City of Tacoma
TCLP	Toxicity Characteristic Leaching Procedure
WDFW	Washington Department of Fish and Wildlife

1.0 OVERVIEW

The U.S. Environmental Protection Agency (EPA) has written this Responsiveness Summary to respond to public comments received regarding the Proposed Plan for cleanup of the former Asarco Smelter Site. EPA initially held a public comment period from August 12 through October 11, 1994. At the request of members of the community, the comment period was extended to November 10, 1994. This document reflects all of the comments that were either voiced at one of the two public meetings held during the comment period, or submitted in writing. Questions that were asked and answered at the public meetings, held on August 30 and September 19, 1994, are recorded in the meeting transcripts, and are not included in this document. The transcripts are available in the Administrative Record for the Site is located at EPA Region 10, the Main Branch of the Tacoma Public Library and all of the Information Repositories listed in Table B-1 in Appendix B.

In addition to EPA's efforts, Asarco solicited public comments on EPA's Proposed Cleanup Plan as well as on an "Agreement in Principle" between the company and local governments for future development of the site. Comments received by Asarco in response to its request have been summarized and are included with Asarco's comments on the Proposed Plan, Section 3.0 of this document. The Responsiveness Summary meets the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

1.1 SITE BACKGROUND

The former Asarco Smelter project is part of the Commencement Bay Nearshore/Tideflats Superfund Site in Tacoma, Washington. The Commencement Bay Site was placed on the National Priorities List (NPL) in September 1983. The Asarco Smelter Facility and the adjacent Tacoma Yacht Club breakwater (slag peninsula) are located along the shoreline in Tacoma and Ruston, Washington.

The former Asarco Smelter Site (the Asarco Site) consists of the 67-acre smelter property and the 23-acre adjacent peninsula. Many of the facility buildings and structures were erected on slag fill (a black, rock-like byproduct from the smelting process), which extended the existing shoreline when molten slag material was poured into Commencement Bay during smelting operations. An estimated 15 million tons of slag exist on the smelter property and along the slag peninsula.

Metal smelting and refining operations were active at the Asarco Site from the late 1800s until 1985 when the smelter facility was closed. During that time, lead and copper were refined from metal-bearing ores and by-products of the smelting operations were further refined to produce other marketable products such as arsenic, sulfuric acid and sulfur dioxide. Metals and organic compounds were released into the air, soil, and Commencement Bay as a result of these operations. Metals in the slag, or that were released into the soil have migrated into the Bay and into groundwater underneath the Asarco Site.

Over the past several years, samples of soil, slag, surface, and groundwater have been taken at the Asarco Site. Elevated concentrations of heavy metals and some organic compounds were detected in soil and slag throughout the property as well as in the Bay, groundwater and off-shore sediments. The contaminants of most concern for possible effects to public health and the environment include: arsenic, cadmium, chromium, copper, lead, nickel, silver, zinc, and dimethylaniline.

Samples show that the principal threat to human health and the environment is the contaminated material in the "source areas." EPA and Asarco have identified the following six source areas: the Stack Hill, Copper Refinery Area, Cooling Pond, Arsenic Kitchen, Fine Ore Bins Building, and the Southeast Area of the Plant. These are areas that have the highest known concentrations of metals and/or organic compounds and continue to act as the primary known sources of contamination to the Bay and groundwater. Elevated arsenic concentrations ranging up to 403,100 parts per million (ppm) were detected in soil samples at one source area at the Asarco Site. Highly mobile organic compounds are also considered a principal threat because they are leaching out into surface and groundwater that is flowing into Commencement Bay.

Cleanup actions are necessary at the Asarco Site because it currently poses long-term cancer risks for workers, possible future visitors or residents, sealife, and animals. EPA has selected a comprehensive cleanup strategy in order to address the multiple sources of contamination at the smelter property and along the slag peninsular EPA identified a range of alternatives (series of choices) to achieve cleanup objectives and goals for the Asarco Site. These alternatives are summarized in Table 7-1 of the Record of Decision. EPA has evaluated the choices and public comments on the Propose Plan, and has selected the Phase I (source control) cleanup remedy for the Asarco Site. In addition to evaluating cleanup options, representatives of Asarco, the City of Tacoma (Tacoma), the Town of Ruston (Ruston), and the Metropolitan Park District (the Park District) have formed a "land use committee" which has negotiated an "Agreement in Principle" that calls for preparation of a consensual Master Use Plan for future development of the Asarco Site after cleanup.

1.2 PROPOSED PLAN FOR CLEANUP

One of EPA's objectives in issuing the Proposed Plan is to enable the public to participate in the process for selection of a cleanup approach for the Asarco Site. Public comments are solicited to determine whether the range of approaches is adequate, whether the discussion of differences between approaches is reasonable and comprehensive, whether EPA has made good choices in developing a preferred alternative, and whether the choices made will meet community objectives for the Asarco Site.

In developing the Proposed Plan, EPA considered the following nine legally mandated Superfund evaluation criteria:

(1) Overall protection of human health and the environment;
(2) Compliance with federal and state environmental standards;
(3) Long-term effectiveness and permanence;
(4) Reduction of toxicity mobility, or volume through treatment;
(5) Short-term effectiveness;
(6) implementability;
(7) Cost;
(8) State acceptance; and
(9) Community acceptance.

The Preferred Alternative, outlined in EPA's Proposed Plan, addressed contamination of plant site soils, the slag peninsula, groundwater, and surface water. It was based on the alternatives summarized in Table 7-1 in the Record of Decision, plus additional elements that EPA believes were necessary for a comprehensive cleanup. The individual components of the Preferred Alternative included excavation and treatment of soils from the source areas; disposal of soil and other materials; capping the entire Asarco Site; demolition of the remaining buildings; replacement of the entire surface water drainage system; shoreline armoring of the plant site and slag peninsula; abandonment of the production well; monitoring of surface and groundwater and sampling of marine sediments; safety measures; integration of cleanup with land use plans; cleanup schedule; and costs.

1.3 SELECTED REMEDY

EPA has carefully evaluated all of the cleanup alternatives and public comments received on the Proposed Plan, and has selected a cleanup remedy to control the source of contamination at the Asarco Site. This selected remedy is Phase I of the comprehensive cleanup plan, and is described in detail in Section 9.0 of the Record of Decision. In general, the selected remedy for source control of the contamination at the Asarco Site includes excavation of source area soils, demolition of the remaining buildings and structures, disposal of the source area soils and demolition debris in an on-site containment facility (OCF) which meets or exceeds regulatory standards for hazardous waste landfills, cap the entire Site except for the OCF which has its own cover, replace the entire surface water drainage system, armor portions of the plant site and slag peninsula shoreline, continue to monitor the surface water and groundwater, sample marine sediments and develop and implement an enforceable program of restrictions and guidelines to supplement the actual cleanup activities to ensure that the remedial action remains protective.

1.4 SUMMARY OF COMMUNITY INVOLVEMENT AND CONCERNS

EPA has placed a high priority on community involvement because many Ruston and North Tacoma property owners and residents may be affected by EPA's chosen cleanup approach. EPA recognizes that, in addition to cleaning up contamination at the Asarco Site, the community is very interested in the future use of this property. Although the primary mission of the EPA is to design a cleanup that protects human health and the environment, EPA believes that this can be accomplished with future development of the Asarco Site in mind. To achieve this goal, significant citizen participation has been important to EPA's process for selecting a remedy. The following activities were undertaken by EPA to seek public input:

- Availability Sessions where citizens could visit one-on-one with EPA and Asarco to discuss cleanup plans,

- Meetings with interested small groups to discuss investigation findings and cleanup alternatives;

- Interviews with individual citizens to improve understanding of community concerns;

- A 90-day public comment period to provide citizens with an opportunity to review the Proposed Plan and other documents related to the cleanup and submit comments to EPA;

- Two public meetings, held on August 30 and September 19, 1994, to answer questions and obtain citizen input on EPA's Proposed Plan; and

- Meetings with the Ruston/North Tacoma Coordinating Forum which is comprised of representatives from local, state and federal municipalities or agencies.

Transcripts of the August 30 and September 19 public meetings and the public comment letters and cards received by EPA are part of the Asarco Smelter Administrative Record, which is available for viewing at EPA Region 10, the Main Branch of the Tacoma Public Library and all of the information repositories listed in Table B-1 in Appendix B. In general, the commenters expressed concerns about the soil, groundwater, and surface water contamination, and its health effects; the longevity and stability of on-site containment/disposal; the effects on future land use; and issues involving the cleanup plan design, costs, and benefits to the community from future development.

The next six paragraphs provide a summary of comments received and are followed by a detailed response section to specific comments. During the comment period, numerous commenters expressed preferences regarding the cleanup of the contaminated soils. Some commented specifically in relation to the future development of the Asarco Site. Many commenters stated a preference for on-site containment of the contaminated soils, reasoning that only by approving the less expensive OCF alternative would there be money left over to develop the Asarco Site. Many stated a preference for on-site containment, reasoning that an OCF is safe, environmentally effective, and the most economical alternative. Other commentors opposed on-site containment because of concerns regarding the stability, longevity, and safety of an OCF, and stated that development should not be an issue in choosing the best cleanup decision. Several commenters felt that the development money Asarco has offered may have already tainted the cleanup decisions of EPA and the local communities. Other commenters suggested that a combination of on-site containment, treatment, and/or off-site disposal would be the most effective remedy for the contaminated soils and other materials.

Contamination in the groundwater, surface waters, and sediments was a concern of some of the commentors; they felt that EPA did not adequately address this issue in the Proposed Plan and offered opinions and suggestions regarding the remediation of these areas.

Many commenters voiced their opinions or suggestions regarding the proposed treatment of soils at the Asarco Site. Some commenters expressed a preference for on-site treatment prior to disposal; others opposed on-site treatment because of issues regarding stability, post-cleanup monitoring, and cost of treatment. Several commenters made suggestions of alternative treatment methods for the contaminated soils.

Many commenters also voiced their opinions and offered suggestions regarding the nature of future development at the Asarco Site. Some commenters expressed appreciation for the efforts of Ruston, Tacoma, the Park District and Asarco in negotiating a Master Development Plan and were eager to see development of the site. Other commenters disagreed, referring to the plan as a "bribe" to the nearby residents of Ruston and Tacoma to influence their acceptance of a less expensive OCF without treatment.

Some commenters expressed appreciation for past and current efforts on the part of EPA and Asarco; others expressed criticism of one or both organizations. Several commenters indicated disapproval of Asarco and what they viewed as action motivated only by organizational self-interest, which was seen as running counter to public interest. Some commenters expressed the opinion that Asarco had excessively endangered public health in its pursuit of profits Asarco provided comments to EPA' that are included in Section 3 of this Responsiveness Summary. Additional public comments received by Asarco are also included in this section. The next section (Section 2) provides detailed responses to public comments communicated verbally during the public meetings, and written communications received by EPA during the 90-day public comment period.

2.0 PUBLIC COMMENTS AND EPA RESPONSES

2.1 SOIL TREATMENT

1. COMMENT: Several commentors recommended against treatment of contaminated soil. Several commentors questioned the long-term effectiveness of the proposed soil treatment. Some commentors stated that encapsulation/stabilization is an unproven technology, is difficult to monitor over the long-term, does not reduce the volume of the contaminants, and/or is not cost effective. Some commentors expressed the opinion that there may be serious risks if the resulting mixture were spread over the Site, because the small concrete particles may break down with an end result that is worse than the current situation. Several commentors added that this would have a devastating impact on future Site development. One commentor also stated that, due to the unknown long-term effectiveness of stabilization, this option does not meet the nine evaluation criteria.

RESPONSE: Although EPA is not selecting soil stabilization/solidification for the Asarco cleanup, it has been used at a number of Superfund sites around the country. These technologies are relatively new, such that no data exists that would show how the stabilized material would hold up 50 or 100 years from now. However, tests have been developed to simulate conditions in the future.

EPA believes that many commentors expressed a valid concern about the future monitoring of the treated soils if the soils were placed in various areas beneath a site cap. Although EPA believes that an effective monitoring system could be designed to detect if treated soils were contributing to groundwater contamination, it believes that the leak detection and collection system for the OCF is better with respect to identifying any future problems. Monitoring any Superfund remedy over the long-term always presents site specific challenges and EPA believes that a successful monitoring program can be developed for the Asarco cleanup.

2. COMMENT: A few commentors, including the City of Tacoma Environmental Commission and Citizens for a Healthy Bay (CHB), expressed the opinion that long-term monitoring of the Asarco Site after the cleanup activities were completed would be more difficult and costly if the soil were treated because the treated material would be placed throughout the Site. CHB also expressed the concern that deed restrictions would be necessary.

RESPONSE: In EPA's original proposal, treated soils would have been consolidated in the excavated or other areas on the Site not impacted by groundwater, not spread around. The groundwater monitoring program that EPA would have required for treated soils would have been equivalent to that selected for the OCF.

Deed restrictions and institutional controls will be necessary regardless of the remedy selected because some hazardous contaminants will remain on site under all of the alternatives.

3. COMMENT: Several commentors stated a preference for on-site treatment of metals and other contaminants of concern prior to disposal. One commentor cited off-site health risks, Potentially Responsible Party (PRP) liability, and cost benefits as reasons for on-site treatment.

RESPONSE: EPA has selected disposal of excavated source area soils in an on-site containment facility (OCF) without requiring soil treatment prior to disposal. As discussed in section 7.2. in the Record of Decision (ROD), EPA compared the potential movement of contaminants out of the OCF of treated and untreated soil. EPA found that the potential difference in leachate between treated and untreated soil disposed in an OCF was minimal if the good quality of the cap and bottom liner was maintained.

EPA believes that disposing the source area soil in an OCF and capping the rest of the Site will alleviate any potential health risks to adjacent neighborhoods. Asarco will be responsible for the cleanup regardless of the remedy selected. Most of the public comments received supported an OCF more than soil treatment because an OCF cost less and would allow future development to occur. EPA believes that the additional cost for soil treatment would not result in a more effective remedy over the long-term.

4.   COMMENT: One commentor suggested that EPA perform a series of small pilot tests to determine the effectiveness of the proposed treatment on the contaminated soil prior to engaging in final cleanup activities.

RESPONSE: In May 1994, EPA, Asarco and Asarco's contractor ITEX, conducted a pilot-scale treatment project that solidified approximately 500 cubic yards of soil at the former Asarco Smelter Site. The results are described in Appendix C of the ROD. Additional information can be found in section 2.5 of the Administrative Record.

5.   COMMENT: One commentor expressed concern that treating the soil with lime may create a different mixture of contaminated elements, and wondered if the EPA has conducted tests to ensure that this does not occur.

RESPONSE: The pilot-treatability study used lime, or calcium oxide, as one of the primary additives. EPA found that "a different mixture of contaminated elements" was not created, rather the metals were simply bound up within the cement. The results of this study can be found in the Asarco Smelter Administrative Record and are described in Appendix C of the Record of Decision (ROD).

6.   COMMENT: Citizens for a Healthy Bay (CHB) does not support soil stabilization and commented that there are no assurances that the treated soil will remain stable and will not leach 10, 50, or 100 years from now. They stated that the long-term leachability of the stabilized material is difficult to determine because the method used to evaluate the long-term mobility, the Municipal Waste Extraction Procedure (MWEP), utilizes a 30-day test, and the results of some of the leachability tests were not made available to the public.

RESPONSE: MWEP and the Toxicity Characteristic Leaching Procedure (TCLP) are reasonably good predictors of future leaching, but the treatment technology is so new that actual results of how well treatment works over a long period of time are not available. EPA believes that the MWEP and ANS 16.1 water leaching tests, which are frequently used today at municipal waste facilities, are good predictors of the future impacts of rainwater and surface water coming into contact with treated soils. A summary of the results of both of these tests are attached in Appendix C and the complete document is located in the Administrative Record for this Site.

7.   COMMENT: The Tacoma-Pierce County Health Department stated that it would only support treatment if EPA could assure that treatment would be a "permanent fix that would never leach."

RESPONSE: EPA cannot make this guarantee for either disposal option for contaminated soils at the Site. The only alternative that may be able to meet this criterion is "off-site disposal." However, off-site disposal is much more expensive than other available options. Further, even with off-site disposal, it is not possible to remove all contaminated material so some contaminated soil and slag would still remain on Site and need to be capped. For more information on the reasons for this decision to select an OCF, see Section 8.0 in the ROD.

Alternative Treatment Methods

8.   COMMENT: Several commentors indicated that additional treatment technologies exist to remove and/or destroy metals in the soil and that these technologies should be considered in the cleanup plan. Citizens for a Healthy Bay (CHB) requested that the time to consider

different cleanup options at the Site be extended to assess the results of alternative treatment studies and allow for public review. CHB also requested that copies of all information received by EPA regarding treatment technologies be sent to their office for review and publication. Two commentors stated that the public comment period should be reopened when the results of any treatment technology are received by EPA.

RESPONSE: Under an EPA Administrative Order on Consent, Asarco conducted a literature search for treatment technologies which would eliminate metal contamination from soils at the former smelter site (see the "Treatability Literature Study Report," May 12, 1992 in Section 2.5.5 of the Administrative Record). Through this literature search it appeared that soil stabilization/solidification was the most appropriate treatment technology for the contamination at this Site. During the public comment period, another treatment vendor claimed that his company's soil-washing technology could remove the metals from the soils for approximately the same cost as on-site containment. EPA has been working with this vendor since the first public meeting, but as yet, has not received additional information which indicates that this treatment process is effective. EPA has informed the vendor of its continued willingness to receive information. The additional soil treatability information on the MWEP test was sent to Citizens for a Healthy Bay. EPA did extend the public comment period for an additional 30 days.

9. COMMENT: Several commentors suggested that chemically extracting the metals from some of the more contaminated soils would be an environmentally and economically sound alternative to stabilization and/or land disposal.

RESPONSE: To date EPA has not identified a chemical-extraction process which is effective for the metals which are found on Site.

10. COMMENT: Several commentors suggested a variety of additional treatment technologies for contaminated soils and/or groundwater. Some of the soil technologies recommended are: (1) bioremediation, (2) combining the metal-contaminated soil with excavated clay and melting the mixture in an on-site kiln, (3) "closed incineration" which is used by oil companies, and (4) the use of any in-situ technologies where possible. In addition, a commentor suggested using wet oxidation of organics, electro-filtration of heavy metals and ozone treatment for groundwater.

RESPONSE: EPA required Asarco to conduct a treatability literature search report, see reference in Response No. 8. In this report all of the applicable technologies for treatment of metals contamination in soils were evaluated.

(1) Bioremediation. EPA believes that the commentor is referring to the bioremediation of metals in an artificial wetland environment. If this is the case, there are microbes that can be used to alter the oxidation state of metals, which in some cases may result in the metals becoming less mobile, but this process would not remove the metals from the environment. Biological treatment of leachate that is generated at some sites has also been used, but this type of treatment does not favorably impact the source of the contamination. Conceptually, Desulfouibrio spp. (a type of microbe) can cause metals to be precipitated in sulfides, but this type of treatment has not been shown to be effective on the type or concentrations of waste at the smelter site.

(2) In-situ vitrification of metals in soil, or combining clay with contaminated soils at high temperatures, was explored, but determined not to be cost-effective. One company, Geosafe, has conducted field demonstrations (small scale) of soil vitrification, which would bake the soil into a slag-like matrix. This has not been proved to be effective at full-scale yet.

(3) Closed Incineration. EPA spoke to the project manager of "Seaview" (Bluebell, Pennsylvania) who developed the technology for "incinerating" hazardous compounds, primarily hydrocarbons, found in off-shore drilling materials. This process involves heating the contaminated materials until the hydrocarbons are burned out of the sediments. EPA does not believe that this treatment process would be effective for treating the contaminated soils found at the Asarco Site.

(4) In-situ technologies, such as soil flushing or vitrification could potentially be used at the Site. However, environmentally dangerous chemicals (e.g., strong acids and chelating agents) would have to be used for soil flushing and it would be necessary to be absolutely sure that all of these chemicals could be captured before they discharged into the bay. Additionally, this could be a lengthy and expensive process due to the high metal concentrations found at this Site.

Following completion of the actions under this ROD, EPA will evaluate the need for remedial measures for surface and groundwater. If surface water treatment is necessary, Asarco will be required to evaluate these approaches, along with others. In-situ treatment technologies will be considered where appropriate.

11. COMMENT: One commentor suggested using sulfur instead of lime in the proposed treatment, because the higher pH of lime would increase the solubility of arsenic.

RESPONSE: EPA recognizes that sulfur chemicals are another set of treatment reagents that could be used to produce insoluble species of arsenic. Like the cement and lime based solidification methods, sulfur reagents have to be tested to make sure they are compatible with the particular waste that is being treated. The concerns that EPA has with sulfur chemicals are (1) the treated soil would be "soil-like" which would mean that surface/groundwater would be more likely to come into contact with the treated soil particles and (2) although sulfides are stable in a low oxidation environment, if they are exposed to air, the sulfides can oxidize and release a more soluble form of arsenic and sulfate.

2.2 ON-SITE CONTAINMENT FACILITY (OCF)

12. COMMENT: Numerous commentors expressed their support of the Master Development Plan and stated a preference for on-site containment without treatment. A majority of the commentors reasoned that only by approving the less expensive alternative would there be money available to invest in development of the Asarco Site. In addition, some people expressed the opinion that, besides saving money, on-site containment without treatment would save time. Other commentors reasoned that, as the soil treatment and OCF options are equally protective, the additional dollars that would be required for treatment are better spent on preparing the land for development. One person added that an OCF can always be dug up later if it is determined to be a hazard.

RESPONSE: EPA is required to select a remedy which is protective of human health and the environment. Both soil treatment and on-site containment are protective cleanup options. In this case, EPA further considered the compatibility of protective cleanup plans with future land use plans. EPA believes that the future use of this Site is important and has tried to select cleanup activities that will not prevent reasonable future uses of the Site. EPA has also considered the cost effectiveness of the alternatives. However, it should be noted that EPA's determination that the selected remedy is cost-effective is based on a comparison of the various cleanup approaches described in the Proposed Plan, not on Asarco's ability to afford land development activities.

Contrary to the commentors belief, soil treatment would be completed faster than designing and constructing an OCF. The pilot-treatability test indicated that the soil treatment would take approximately 6 months. However excavating and disposing soils in an OCF could take approximately 2 years.

It is true that an OCF could be "dug up" in the future if it is determined that the OCF is not as effective as once thought and/or if a new treatment technology is discovered. However, EPA believes that the likelihood of this happening is small. EPA is selecting a hazardous waste facility (the OCF) as part of its cleanup option because it believes that this unit can be constructed in a manner which will effectively isolate the waste from the environment and be protective of human health and the environment over the long-term.

13. COMMENT: Several commentors questioned the integrity and effectiveness of on-site disposal, stating that OCF technology is still new and unproven and other waste disposal sites, over time, have all experienced leakage. Two people cited the example of Gas Works Park in Seattle, where the public was assured the soil was safe, but the soil was later discovered to be unsafe and had to be removed at great expense to the taxpayer. Another commentor referred to an

example several years ago when Tacoma encouraged the development of apartments near its refuse site. The contaminants eventually surfaced and the public had to purchase the apartments at a high price following lawsuits. Additionally, several commentors questioned the leachability of contaminants to groundwater and surface waters from an OCF.

RESPONSE: Many of the landfills which have failed in the past have been municipal solid waste landfills that have not been constructed with multiple liners and caps which would be required at the Asarco Site. These landfills have contained a variety of wastes (e.g., solids, liquids, and hazardous constituents). Over time, many of these incompatible wastes have mingled creating either the release of toxic leachate or methane gas. The OCF, which has been selected for this Site, will not contain different types of wastes, rather it will contain "inert wastes" (wastes that are not chemically reactive with each other) such as contaminated soil and demolition debris (excluding wood). Since the metals in the source area soils have been found to become mobile when water passes through them, it will be important to design a cap which strictly controls surface and groundwater infiltration.

14. COMMENT: Several commentors raised questions regarding the stability of an OCF or landfill in what they considered to be the probable event of a major earthquake. One of these commentors expressed the belief that, due to the geology of the area, an earthquake-triggered (or other naturally-occurring) slide would carry contaminated materials into the bay. One commentor wondered if the Site was fundamentally suited for an OCF.

RESPONSE: Preliminary seismic evaluations of the smelter plant area were conducted during the Feasibility Study. These evaluations indicate that this area is suitable for an OCF (e.g., it is not located on a fault line). However, an additional seismic evaluation of the area where the OCF will be constructed will be a requirement of the Remedial Design/Remedial Action work plans that are developed after the ROD is signed.

15. COMMENT: Several commentors expressed the opinion that if the OCF alternative is chosen a multiple cell approach should be used, with the more contaminated soils stored and/or treated and disposed in a separate cell. They reasoned that this approach would allow for one more level of protection for a leaking OCF and enable removal of the contaminated soils in the future if necessary. Another commentor added that separate cells would offer more precise monitoring capabilities, because the contaminated material ranges over three orders of magnitude in contaminant concentration. Another commentor suggested that, by using separate cells, the more contaminated soils could be treated when new technologies become available.

RESPONSE: Because the type of material to be placed in the OCF is relatively similar (metal contaminated soil and debris) EPA does not believe that there are significant advantages to storing the waste in separate cells. Segregating soils based on the metals concentration may be appropriate if there were a promising soil treatment technology pending and EPA believed that certain soils would be a good candidate for treatment. However, this is currently not the case.

The reasons that landfills are normally separated into multiple cells is to (1) separate incompatible wastes and the leachate from those wastes and (2) to limit the open portion of a large landfill that will operate over many years so as to limit the area available for collection of precipitation. Under this scenario, each cell would be constructed and covered prior to constructing another cell. Neither of these reasons are relevant to the Asarco OCF as the waste to be placed is not incompatible and the duration the OCF will be open is short.

16. COMMENT: One commentor stated that EPA did not present soil treatment before disposal in an OCF as an option in the Proposed Plan, and that treating the most contaminated soils may be a way to mitigate the high costs of remediation and still allow for future development.

RESPONSE: EPA presented this alternative, soil treatment before disposal in an OCF, in Section (H)(7) of the Proposed Plan. The estimated cost of this alternative was $65.5 million. When the Proposed Plan was issued, EPA did not believe that it would be necessary to dispose treated soil in a hazardous waste landfill. Therefore, the costs of disposing treated soils were calculated based on a solid waste landfill. This cost was $70.2 million because hazardous demolition debris would still need to be properly disposed off-site. Disposing treated soil and debris would be more expensive than using an OCF.

17. COMMENT: Two commentors expressed concern that tourists, families, developers, and/or restaurateurs would be hesitant to visit or build on a hazardous waste site that may potentially leak.

RESPONSE: The hazardous waste to be disposed in the OCF would be isolated from potential access by people through a multilayer cover and the legal restrictions requiring that the cover be maintained. Further, as part of the future land use activities sponsored by Asarco, Tacoma, Ruston and the Metropolitan Park District, interviews were conducted with bankers and future developers to determine if there would be a market for development on a remediated Superfund site. The research indicates that constructing an on-site landfill does not appear to pose significant barriers to future uses of and investment in the Site.

18. COMMENT: One commentor stated that the option of including both soil and demolition debris in an OCF should have been presented in EPA's evaluation of cleanup options.

RESPONSE: This option was included in EPA's Preferred Alternative, on page 14 in Section (G)(1)(b) and (c).

19. COMMENT: One commentor suggested that the "ditch" leading up to the railroad tunnel would be an ideal location for the OCF, because it is unattractive and in need of remediation.

RESPONSE: EPA does not believe that this would be an "ideal" location because the gully located on the south side of the stack hill is private property and may potentially be considered a wetland. In addition, there are many areas along the hillsides where groundwater exits and creates small ponds and marshes at the base of the gully. It is important to select an area for disposal of contaminated materials where surface water and groundwater can be controlled.

20. COMMENT: One commentor inferred that, because Hydrometrics (the contractor hired by Asarco to design the OCF in the Feasibility Study) is a subsidiary of Asarco, their assurances regarding the safety and stability of an OCF cannot be taken seriously.

RESPONSE: EPA expects Hydrometrics to perform all of its work in accordance with appropriate professional standards regardless of who owns the company. In addition, EPA and its own Consultant, ICF/Kaiser Engineers, Inc., have carefully reviewed Hydrometrics' work to ensure that Hydrometrics' data-gathering, analyses, findings, and conclusions, including with respect to the construction of an OCF, have been performed in accordance with acceptable methods and legal requirements. Further, EPA's in-house technical personnel have conducted their own independent analysis of an OCF and have concluded that it can be constructed in a manner that is protective of human health and the environment.

21. COMMENT: One commentor requested that EPA provide an example of an OCF that has been around for 50 years in a geographically similar area and exposed to an equivalent amount of water runoff. He also added the question: If the soil is so stable, why then is there contamination in the surface water?

RESPONSE: Because there were no requirements for double-lined landfills with separate leachate detection and collection systems before 1984, specific examples of the performance of double-lined landfills more than 10 years old are not available.

The contamination that is found in the surface water is primarily from soil particles being carried by the water (total metals) and not from metals leaching off soil particles into the water (dissolved metals).

22. COMMENT: One representative from the Washington and North Idaho District Council of Labor expressed opposition to on-site containment because of the poor labor relationship that his union is currently experiencing with Hydrometrics or Asarco.

RESPONSE: EPA has no authority to mediate-labor disputes between Asarco and its contractors. EPA requires, however, that Asarco comply with worker health and safety requirements at all times during performance of cleanup work.

23. COMMENT: One commentor supported the use of pre-stressed concrete in the construction of an OCF.

RESPONSE: Although concrete liners and caps could be constructed to prevent contaminants from migrating out of the OCF or prevent water from migrating into the OCF, concrete has a higher tendency to fracture. If this occurred in the liner, it would be irreparable, whereas clay has the capability to reseal itself if water were to contact it in the future. Experience has demonstrated that concrete, or asphalt caps, generally require more maintenance than clay and synthetic caps.

24. COMMENT: One commentor stated that concentrating contaminated residential soils in an OCF close to the shoreline would further aggravate the local environment.

RESPONSE: Residential soils will not be disposed in an OCF, but will be used as a sub-base to the low permeability cap (see Figure 7-1 in the ROD) that will be placed on the Site.

25. COMMENT: One commentor asked if releases from an OCF could be monitored if the Site is already contaminated and wondered if existing contamination would make it more difficult or unlikely to detect leaks from an OCF.

RESPONSE: EPA has many years of groundwater data from this Site that can serve as a baseline prior to construction of the OCF. EPA plans to continue groundwater monitoring before, during and after cleanup. Therefore, we will be able to evaluate the groundwater contamination trends before and after construction, of the OCF. In the event that contaminants begin to leach out of the OCF, they will be detected as increases above then existing conditions via the groundwater monitoring program.

26. COMMENT: One commentor stated that a hazardous waste facility, under Resource Conservation and Recovery Act (RCRA) siting requirements, would not typically be in a wet climate with full public access and immediately adjacent to an exceptional water body, such as Commencement Bay. For these reasons, if soil treatment is ineffective, the proposed OCF should be modified to use additional clean soil as a cover to diminish future exposure, with the contaminated soils segregated by level of contamination into separate cells. This commentor added that the OCF should be built like any other RCRA facility, with the soils receiving the same amount of treatment as would be required if they were to go to the RCRA facility in Arlington, Oregon.

RESPONSE: EPA agrees that a new hazardous waste landfill typically would not be sited in this type of location, assuming that the area was relatively clean. EPA and the State try to avoid introducing contaminants to pristine or clean areas. But the smelter site is not such an area and it is generally recognized that a significant amount of contamination, such as 15 million tons of slag, cannot be removed from this location. Accordingly, EPA believes that construction of a landfill in accordance with federal and state requirements at this location, given existing contaminated conditions, is an acceptable part of the overall cleanup. EPA is not requiring treatment of soil prior to disposal in the OCF because the OCF can effectively isolate the soil from the environment, see Section 9.9 of the ROD. See Response to Comment No. 15 regarding construction of separate cells.

27. COMMENT: One commentor stated that the siting decision for the OCF needs to carefully consider the hydrogeology of the Asarco Site. An impermeable structure, such as an OCF, is likely to alter the current groundwater system and raise the water table around the OCF. He expressed the opinion that the OCF should not be constructed atop a shallow aquifer if other more protective locations exist. Other commentors wondered if there would be any way to pump out water that may seep into the OCF before it moves from the OCF into Commencement Bay.

RESPONSE: All groundwater and surface water which currently flows across or through the central area of the Site, where the OCF will be located, will be rerouted through new drainage systems or diversion trenches. It is not likely that the groundwater table will rise as a result of these activities.

In addition, a thick silt aquitard lies beneath the shallow aquifer in this location and will prevent rerouted or displaced groundwater from migrating to the deeper aquifer.

The OCF will be designed so that groundwater is unlikely to come into contact with the OCF and so that surface water (rain water) will be diverted. In addition, EPA believes that the minimal amount of leachate which may be generated inside the OCF will be handled by the leachate collection and removal system before it is released into the groundwater or the bay.

28. COMMENT: A few commentors believe that EPA should consider the potential for including contaminated sediments in the OCF. In contrast, the Town of Ruston commented that it is opposed to using the OCF for the disposal of dredged, dewatered marine sediments, due to the necessity of reopening a closed OCF, the potential for adverse chemical reaction with materials in the OCF, and its adverse impact on future development. Tacoma, the Metropolitan Park District and Asarco also opposed disposing sediments in the OCF.

RESPONSE: At this time, it has not been determined that off-shore sediments need to be dredged and disposed. However, Ruston, Tacoma, the Metropolitan Park District and have presented several reasons why this material should not be disposed in the OCF should dredging and disposal be required in the future: (1) the sediments will be very wet and may introduce water into the OCF that could mobilize the metals on the soils, and (2) there may not be enough room remaining in the OCF after the soils and demolition debris are disposed. Although sediments could be dried before they are disposed, it is unlikely that sufficient capacity could be added for the sediments without interfering with land use plans. For these reasons, EPA agrees with the commentors opposed to disposing sediment in the OCF. Other alternatives for disposing dredged sediments will be evaluated by Asarco and EPA.

29. COMMENT: One commentor stated that because the Tacoma Asarco Smelter processed ores that other smelters did not want, all of the contaminated soils should be consolidated on the site.

RESPONSE: EPA agrees that consolidation of soils on site makes sense but not necessarily for the reason provided by the commentor.

30. COMMENT: The Puyallup Tribe of Indians (the Puyallup Tribe) is concerned that the construction of an OCF before implementation of a source control strategy may preempt the future remediation of groundwater, therefore they request the construction of the OCF not occur until after the groundwater studies are completed. The Tribe stated that a source control strategy must develop specific plans for control of permitted and unpermitted point source and non-point source discharges and that "No remediation should begin unless source control can be implemented and enforced." The Tribe added that the cleanup of this Site must ensure that there will be no further pollutants entering the environment from any source.

RESPONSE: The Tribe appears to be stating that EPA should directly reduce levels of contaminants in surface water and groundwater prior to removing contaminated soil and constructing an OCF for disposal of such soil. The Tribe's concept of "source control" appears to be to treat contaminated surface water and groundwater prior to discharge.

EPA agrees with the Tribe's proposed result but not with its recommended sequence of cleanup activities. Because contaminated soils existing at the Site are the primary source of contaminants found in surface water and groundwater, EPA believes it is important to first remove the most contaminated soils from the primary source areas and isolate them from surface water and groundwater so the connection between the sources of contamination and the discharges to Commencement Bay is severed.

After the sources are removed and isolated in the OCF, the entire Site is capped, and a new surface water drainage system is installed, EPA will monitor the levels of containments in discharges from the Site. If these levels continue to exceed acceptable requirements, EPA will determine what further actions, including water treatment, are necessary to reduce the discharge of contaminants into Commencement Bay. EPA notes that the cleanup levels for surface water are consistent with the Tribe's water quality standards. By promulgating its water quality standards, the Tribe appears to recognize that there are acceptable levels for pollutant discharges other than "no further pollutants."

2.3 CAPPING

31. COMMENT: One commentor preferred that Asarco cap the land "as is" rather than excavating and consolidating the contaminated soils.

RESPONSE: The soils located in areas identified by EPA as "source areas" have very high concentrations of contaminants which are mobilized by contact with groundwater. In order to address the significant groundwater problem at the Site, EPA believes it is necessary to remove these soils before capping the entire Site.

32. COMMENT: There were several comments regarding the capping materials that were proposed to be used for a Site cap. Two commentors believe that the "clean" soils from Pt. Defiance are probably also contaminated with Asarco emissions; another commentor was concerned about contaminants from the excavated Study Area soils potentially leaching into the Bay and another commentor suggested that contaminated sediments as well as Study Area soils should be included in the cap.

RESPONSE: All soils used for the top layers of the cap will be sampled to verify that they are clean. Although the Ruston/North Tacoma soils do not leach metals into surface water or groundwater, EPA believes that the cap will protect the contaminated soil particles from being washed into the bay by surface water. At this time, EPA is not sure whether sediments will need to be dredged or not.

33. COMMENT: Several commentors expressed the opinion that the capping or OCF soil cover should be greater than 2 feet so more substantial vegetation can be planted on top without breaching the cap. One commentor added the opinion that a 1-2 foot soil cap would not be sufficient to ensure permanent protection of construction, public access, utility work, and other activities that may occur on site.

RESPONSE: The total thickness of a multilayer soil cap is at least two and a half feet; for an OCF the thickness is at least five feet. The 1-2 foot soil cap required for the OCF would be in addition to filter material, one foot of drainage material, a fabric liner and two feet of compacted clay. For the soils cap, the one foot of clean soil would be in addition to 6 inches of gravel and one foot of clay. EPA notes that plans for development of the Site may result in even thicker layers of soil in the cap or above the cover of the OCF.

34. COMMENT: Two commentors stated that clay capping is susceptible to cracking. One of these commentors suggested using a geomembrane liner in combination with the low permeability soils as a substitute for clay capping. A few commentors are concerned about sulfide formation if anything other than a "soil only" cap is used or if waste is buried deeper than four feet (sulfides increase the possibility of a "reducing" environment).

RESPONSE: Although clays that dry out are susceptible to cracking, the advantage of clay is that once surface water does begin to migrate through the cracks it rehydrates the clay and the cracks are resealed. Although synthetic liners are often used in conjunction with clay, it is for this reason that synthetics are rarely used alone. A synthetic liner may be used as part of the cap and liner of the OCF and will not be used as part of the site wide cap.

EPA has not experienced sulfide formation at sites where wastes were buried deeper than four feet. Also, see Response to Comment No. 11.

35. COMMENT: The Tacoma-Pierce County Health Department's comment letter expressed the opinion that the placement of contaminated residential soils under a cap containing one foot of low permeability soils is not appropriate because the soil would be considered dangerous waste if generated elsewhere in the state. It stated that the original plan was for the residential soils to be disposed at an off-site landfill and asks how this fits into the proposal to use soils as fill material on the Asarco Site. The Town of Ruston supported using Ruston/North Tacoma soils as a sub-base for a cap on the Site.

RESPONSE: The Health Department later clarified its comment to EPA's project manager and stated that their primary concern about the Ruston/North Tacoma residential soils was their potential to leach. After EPA explained that the data indicated that these soils do not significantly leach above regulatory standards with acid or water extraction, the health department representative agreed that the proposed method of disposal was sufficient.

The Ruston/North Tacoma Study Area Record of Decision (June, 1993) stated that the residential soils would be dispose off site unless an alternative method of disposal was selected in the ROD for smelter cleanup. To determine whether it would be acceptable to the community, EPA proposed using these soils as a sub-base for a cap in the Proposed Plan for the smelter cleanup.

36. COMMENT: One commentor suggested that the contaminated Ruston/North Tacoma soils should not be placed under future parks, open space, or in areas such as streams crossing the Site.

RESPONSE: Since these soils will be beneath a protective cap, EPA believes that these types of restrictions for the placement of residential soils are not necessary. In the event that trees or vegetation that have deeper roots will be planted in parks or open spaces, the thickness of the soil covering can be modified appropriately. Presently, EPA is not aware of any streams crossing the Site.

37. COMMENT: One person was concerned that capping soils in place may still allow contaminants to leach into groundwater aquifers and the bay. He stated that the soil should be removed if the concentrations are dangerous.

RESPONSE: The most highly contaminated soils will be excavated. The Site soils which will not be excavated do not appear to be primary sources of groundwater contamination. However, because rainwater does contact these soils, soil particles are washed into the bay. EPA believes that a clean soil and clay cap will prevent rainwater from coming into contact with the contaminated soils and will prevent contaminated soil particles from washing into the bay.

38. COMMENT: A commentor stated that the cap should be designed to accommodate underground parking.

RESPONSE: EPA's paramount interest is maintaining the integrity of the cap. If an underground parking lot can be constructed so as not to compromise the integrity of the cap, EPA will consider it along with other land uses that may be proposed.

2.4 SHORELINE

39. COMMENT: One person commented that the entire slag face should be securely enclosed so that no leaks are possible.

RESPONSE: If a non-permeable (leak proof) barrier of some type is placed securely against the slag face a "bathtub" effect will be created on the Site. Right now, hundreds of gallons of groundwater move through the Site each day. Placing a barrier at the slag face would cause this water to back up. EPA believes that the shoreline armoring approach will prevent erosion, but still allow groundwater to move into the bay.

40. COMMENT: The Washington Department of Natural Resources (DNR) expressed the opinion that the alteration of the existing shoreline during Site cleanup, as described in the Proposed Plan, may result in the exposure of new slag faces. They believe that this may lead to additional contamination of the bay due to increased toxicity and mobility of contaminants, as well as increase the volume of slag requiring treatment/disposal. DNR cannot support any activities that would create freshly exposed slag and believes that this issue has not been adequately evaluated in the nine criteria analysis. DNR recommended that a quantitative analysis of leaching associated with freshly exposed slag be performed prior to finalizing any plans to cut back the slag.

RESPONSE: EPA anticipates that at least some shoreline armoring will be necessary. EPA shares DNR's concern about exposing too many freshly cut surfaces to bay water since this is the condition when metals in the slag are most leachable. Prior to armoring, EPA will determine if significant erosion is occurring. If it is, and armoring is necessary, DNR, other Natural Resource Trustees, and interested members of the community will be asked to be involved in the development of the remedial design work plans associated with shoreline armoring.

41. COMMENT: DNR stated that armoring and careful design aimed at creating an area which habitat would repopulate is preferred without cutbacks which may lead to further contamination of Commencement Bay.

RESPONSE: EPA agrees with this recommendation.

42. COMMENT: One commentor stated that implementability criteria, overall protection of

human health and the environment criteria, community acceptance criteria, and land use plans have not included the analysis of shoreline armoring design.

RESPONSE: Analysis of this alternative has been included in Section 8.0 in the ROD. However, EPA agrees that additional studies will be necessary to determine the extent and location of armoring and the specific design for anchoring the too (bottom) of the riprap.

43. COMMENT: Citizens for a Healthy Bay and other commentors stated that the Preferred does not give an adequate description of the remediation proposed for the shoreline. They suggested that before the ROD is written, more information regarding the range of alternatives considered, the benefits and drawbacks of each alternative, and site-specific information regarding how this or any other alternative would be implemented needs to be made publicly available. They also questioned whether the riprap will be placed on top of, the existing slag face, or if the slag face will be cut away and then covered with riprap as shown in the feasibility study.

RESPONSE: In the ROD, EPA has modified the Proposed Plan's approach with respect to shoreline armoring based on public comments received. Before developing the design for shoreline armoring, Asarco will be required to conduct additional studies to determine where and to what extent the shoreline is eroding. Sections of the shoreline that are significantly eroding will be armored. At that time, site-specific information will be collected to determine whether cutbacks are necessary and how the riprap will be anchored in order to design the armoring. Citizens for a Healthy Bay, the Natural Resource trustees and other members of the public will be encouraged to participate in this process. Also, see Responses to Comment Nos. 40 and 41.

44. COMMENT: The Puyallup Tribe agreed with the proposal for shoreline armoring. Another commentor requested that the shoreline armoring requirements be flexible enough to accommodate different shoreline needs.

RESPONSE: The shoreline armoring will be designed to accommodate future land uses. Presentation and mitigation of shoreline habitat will also be an objective of shoreline armoring.

45. COMMENT: One commentor stated that a minimum slope of 2.5 (horizontal) to 1 (vertical) needs to be used for any riprap placed on the slag face. It was further added that the explanation was inadequate regarding how this alternative will be implemented without interfering with future sediment remediation. He also stated that it is unclear as to how the armoring will be held in place.

RESPONSE: EPA has been advised by the Corps of Engineers that in most locations, the steepest slope that should be used for riprap armoring is 1 to 1.5, and that areas with slopes greater than this would require cutbacks. Sequencing shoreline armoring and sediment remediation activities will be necessary but at this time the extent of sediment cleanup is not known. By the time work plans will be required for shoreline armoring design, EPA should know what portion of the sediments are contaminated and how these sediments can be cleaned up (e.g., capping, dredging or natural recovery). In many places a "toe" can be excavated out of the slag in order to anchor the armoring. The specific design details of armoring will be determined at a future date. EPA will encourage members of the community to participate in this process.

Natural Resources

46. COMMENT: Several commentors indicated that more emphasis should be placed on developing a range of alternatives for restoration of the natural habitat of the bay, nearshore, and shoreline areas. One commentor suggested that EPA establish an ambitious whole-watershed restoration program as part of the site remediation plan; one commentor stated that shoreline treatment and natural resource restoration options should be explored before a final cleanup design is developed; and one commentor requested that the effects of shoreline armoring on existing habitat be evaluated.

RESPONSE: EPA will work closely with community members and Natural Resource Trustees to develop a comprehensive design plan to try to address all of the commentors concerns. EPA will evaluate whether the mitigation/restoration sites identified by the U.S. Army Corps of Engineers, EPA, U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration (NOAA) in the Commencement Bay Cumulative Impact Study, Volumes I and II (May/June 1993) and the "Vision

Document for Commencement Bay," by the Commencement Bay Cleanup Action Committee (November 19, 1993) are appropriate for the Asarco cleanup.

Although EPA does not believe that "shoreline treatment" is possible, it will identify the effects of armoring on the existing habitat and will explore mitigation opportunities while designing shoreline armoring.

47. COMMENT: Several commentors suggested that the area be returned to a pre-industrial wilderness.

RESPONSE: Although this is a nice idea, it does not appear to be practicable, particularly given the 15 million tons of slag at the Site. EPA's objective is to cleanup the Site so that it will not pose a threat to human health and the environment in the future.

48. COMMENT: Two commentors suggested that the EPA should coordinate its design/cleanup efforts with resource agencies such as National Oceanic & Atmospheric Administration and the Natural Resource Damage Assessment Trustees.

RESPONSE: EPA has been working with these agencies during the RI/FS and decision-making phases and will continue to do so during remedial design and remedial action activities.

49. COMMENT: One commentor expressed the opinion that the alternatives presented (OCF or soil stabilization) are not adequate to accomplish the cleanup correctly. He believes the cleanup should integrate public health issues with the restoration of both aquatic and terrestrial habitats, and the economic thresholds necessary to facilitate quality development.

RESPONSE: The cleanup activities which have been selected are intended to prevent or minimize the contaminant exposure to humans, animals and sealife. Preservation of habitat (or mitigation for adverse impacts to habitat) are also an objective of this cleanup. EPA intends to continue working with the local community regarding the future development of the Site so that "quality development" after the cleanup will also be possible.

50. COMMENT: The U.S. Fish and Wildlife Service commented that they were pleased to see that EPA recognizes mitigation for habitat losses associated with remediation activities as a necessary element in the overall success of the preferred alternative.

RESPONSE: EPA hopes that the U.S. and State Fish and Wildlife Services will continue to be involved in this project.

51. COMMENT: One commentor stated that restoration should be considered while a remediation plan is being developed and that EPA should consider restoring the two natural streambeds that were on the Site. Two commentors requested that as the site remediation plan is finalized, the OCF, liners, and other infrastructure should be made consistent with the restoration of natural streambeds and areas near the shoreline. One commentor suggested that water-sensitive site design that allows natural infiltration of stormwater runoff and reestablishment of natural vegetation be adapted in the location of the two former small streams on the Asarco Site.

RESPONSE: EPA recommends that stream bed restoration be considered under the future development process. EPA notes that CERCLA § 107(f)(1) does not allow for recovery where damages to natural resources have occurred wholly before December 11, 1980. "Natural infiltration" of stormwater runoff is not a good idea if it means that stormwater will come in contact with contaminated soils beneath the Site cap.

Sediments

52. COMMENT: One commentor expressed the opinion that guidelines must be developed for further maintenance and repair of the existing pier structures to minimize impact to sediments.

RESPONSE: EPA's selected cleanup remedy does not address the existing piers. If these piers are to be use for future land use activities, the repair and maintenance will need to be addressed by the Public Development Authority established to oversee future development activities.

2.5 SURFACE WATER

53. COMMENT: One commentor advised that plugging the present drainage system should be done in such a manner as to prevent all water from leaching into the pipes and potentially draining into the bay, and that care should be taken to avoid incidental flushing of the contaminated drain sediments into the bay. This commentor also stated that if applicable and relevant and appropriate requirements (ARARs) are not reached through these surface water measures, surface water treatment be required regardless of its cost. He also wondered if any drainage system presently exists on the slag peninsula. The Puyallup Tribe noted that treatment of surface water (and groundwater) would be difficult particularly during peak flows. The design of the treatment system must account for the worst case scenario instead of allowing for waivers of water quality standards or by-passes.

RESPONSE: Under EPA's selected remedy, all of the existing surface water drainage system will be plugged. If the surface water that flows through the new drainage system does not meet the remedial action objectives (see Section 9.9), surface water treatment will be required to the maximum extent practicable. There is no drainage system on the slag peninsula.

54. COMMENT: The Town of Reston commented that any surface and stormwater management and drainage systems must be designed in consultation with Ruston, Tacoma, and the Park District and meet or exceed all local, state and, federal standards and regulations. The Town of Ruston stated that the surface water drainage system should not be designed as to make routine maintenance and/or any required repair prohibitive.

RESPONSE: EPA will work with the Town of Ruston to accomplish these objectives by involving the Town in development of the Statement of Work and work plans for the design and implementation of the cleanup.

55. COMMENT: The Puyallup Tribe commented that the existing surface water drainage system needs to be plugged and abandoned and a new system constructed. If surface water quality fails to meet federal and state standards, treatment of surface water must be required regardless of cost. The Tribe also requested the creation of detention facilities, such as small streams and drainages, to provide natural areas for wildlife and help control surface water during peak flows. In addition, it requested that Site cleanup ensure that no additional contaminants be released into the environment (e.g., recontaminate the sediments). The Tribe objected to the use of a mixing zone.

RESPONSE: EPA agrees with the need to plug and abandon the existing surface water system and build a new one (see Section 9.3 of the ROD). If surface water cleanup levels are not attained as a result of the new system and capping the Site, the need for treatment will be evaluated.

Detention facilities, silt fences, diversion ditches, cut and fill slopes, will be used as appropriate when soil is being excavated in order to reduce contaminated runoff from excavated areas. Once a soil cap is placed on the Site, EPA will evaluate whether such measures are needed as part of the new surface water drainage system. See Response to Comment No. 51 regarding streams on the Site. EPA believes that construction of a surface water drainage system will prevent the release of contaminants into the bay from surface water. EPA notes that mixing zones are authorized under both state law and Section 9 of the Tribe's Water Quality Standards. Whether a mixing zone is appropriate for the Asarco Site will be determined during remedial design.

56. COMMENT: One commentor stated that the former cooling pond area should be fully remediated to become part of the overall natural area on the Asarco Site, and added that the contaminated soil in the cooling pond area should not be capped in place but removed.

RESPONSE: Approximately seven feet of contaminated soil will be removed from the cooling pond area. If contaminated soil exists beneath this depth it will be capped. Whether this area becomes a "natural area" or a "development zone" will be determined with community participation during future land use meetings.

2.6 GROUNDWATER

57. COMMENT: Several commentors stated that passive treatment of groundwater and surface

water is not adequate and that a source control strategy for point source and non-point source discharges should be implemented prior to commencement of soil remediation. One commentor added that the mass loading of hazardous releases from groundwater and surface water should be fully documented, and a cleanup strategy developed to ensure that contaminants will not continue to enter Commencement Bay. Another commentor requested that the EPA provide more detail on how groundwater will be remediated, and stated that groundwater remediation would result in a significant reduction of ongoing injuries to the bay's natural resources. Two commentors stated that if monitoring reveals that the groundwater fails to meet federal and state standards, the Master Development Plan must allow for the construction and operation of a treatment facility or other contingency plan. The Puyallup Tribe commented that the remediation of soil may interfere with the future remediation of groundwater.

RESPONSE: Efforts to document and evaluate surface water and groundwater contamination are presently underway with the collection of surface water data every month and the collection of groundwater data twice a year. EPA believes that the source control activities will significantly reduce contaminant loading into surface and groundwater. See Response to Comment No. 30 regarding the sequencing of cleanup activities and the basic premise of EPA's source control strategy.

If it is determined that active measures are necessary to clean up surface water and groundwater, a separate analysis and proposal regarding such measures will be issued for public review. EPA does not agree that soil remediation will interfere with the future remediation of groundwater because removal and disposal of soil does not preclude active measures for groundwater.

58. COMMENT: One commentor stated that the preferred alternative will fail to achieve cleanup goals for groundwater because EPA's preferred alternative proposes a waiver of applicable or relevant and appropriate requirements (ARARs) relating to groundwater cleanup and deferral of sediment remediation.

RESPONSE: At this time it is not certain whether source control activities selected by EPA will attain the federal and state groundwater cleanup goals. Accordingly, a temporary waiver of the requirement to meet such goals for this action is appropriate. EPA will continue to monitor the Site and will take the appropriate groundwater cleanup measures if necessary and to the maximum extent practicable.

59. COMMENT: One commentor recommended continual groundwater monitoring at the Site until it is determined that contamination no longer exists.

RESPONSE: EPA and Asarco agreed to a long-term groundwater monitoring plan in October 1994 that requires groundwater monitoring until 1999. EPA anticipates that a cleanup decision for the groundwater will be made by then.

2.7 OFF-SITE DISPOSAL

60. COMMENT: Several commentors expressed a preference for the removal of contaminated soil and off-site disposal citing concerns for the longevity, stability, and future exposure risks of on-site disposal. Some commentors suggested that leaving contaminated materials on site would not provide a permanent solution and would only be a toxic legacy for future generations. Another commentor expressed the opinion that any material hauled off site would be a liability for another community.

RESPONSE: EPA agrees with the commentor's description of the advantages of off-site disposal. But a significant disadvantage is the cost of off-site disposal, nearly $50 million more than disposal in an OCF. Together with the fact that not all contamination will be removed from the Site under any alternative (e.g., 15 million tons of slag cannot be removed) EPA has determined that the cost-effective cleanup solution at the Site is disposal of source area soils in an OCF and placement of a soil cap over the entire Site.

If materials were disposed off-site, it would most likely be placed in a permitted and regulated hazardous waste facility which has already been constructed and permitted and should, therefore, not be a liability for another community.

61.   COMMENT: One commentor expressed the opinion that development of the Asarco Site should not be allowed unless the soil is removed off site.

RESPONSE: EPA believes that the Site can be safely developed if the contaminated soil that remains on site is either isolated in an OCF or capped in place.

2.8   MONITORING/LONG-TERM CONTROLS

62.   COMMENT: Several commentors expressed the opinion that any contaminated material remaining on site in an OCF or underneath a cap should be surrounded by monitoring wells and tested regularly. One commentor asked if a program would be established and funded to ensure ongoing monitoring and repairs when necessary. Another commentor wondered who would be responsible for ensuring that the post-cleanup monitoring is performed.

RESPONSE: Fifty-eight monitoring wells are being used for sampling under the long-term monitoring program. EPA and Asarco have agreed to install additional groundwater monitoring wells after source areas soils have been excavated (see the Post-RI Long Term Monitoring Sampling and Analysis Plan," October 1994). All of the wells in the source areas will be sampled quarterly. During the design of the OCF, EPA will ensure that monitoring wells are in appropriate locations to detect problems with the OCF should they occur in the future. Asarco will be responsible for maintaining and repairing all wells as necessary. EPA will ensure that Asarco monitors the Site after all cleanup activities are completed.

63.   COMMENT: One commentor suggested that local land trusts, public agencies (Housing Authorities), and environmental groups should be involved in future site monitoring and management responsibilities.

RESPONSE: EPA believes it is most appropriate for Asarco to have responsibility for all future monitoring activities. But, EPA is planning to involve other entities in monitoring and management activities.

64.   COMMENT: One commentor suggested that deed restrictions and other legal means for ensuring institutional controls for the Asarco Site need to be strict to ensure a permanent protection for the soil cap placed across the Site and any containment facility built on the site.

RESPONSE: EPA agrees (see Section 9.6.2(a) of the ROD) and will include requirements in the future agreements with Asarco to implement institutional controls including deed restrictions.

65.   COMMENT: One citizen commented that the Park District and Tacoma cannot be counted on to keep their promise of post-development monitoring because they have not kept previous promises.

RESPONSE: Asarco will be responsible for conducting all future Site monitoring, including monitoring after the cleanup has been completed.

66.   COMMENT: One commentor stated that regardless of whether Asarco treats the soil or disposes it in an OCF; monitoring, cap maintenance, air monitoring, and surface water monitoring must be required.

RESPONSE: EPA agrees that monitoring is necessary; these measures are required in the selected remedy found in Section 9.0 of the ROD.

2.9   HEALTH

67.   COMMENT: Two commentors were concerned about health effects from contaminants on site and believe that some of their close family members have suffered from chronic health problems and may have died prematurely as a result of working at the Asarco Smelter.

RESPONSE: EPA expresses its regret for this commentors situation. EPA's cleanup decision is based on the health risks posed by current conditions at the Site. EPA cannot evaluate the extent to which workers' health may have been affected while employed at the smelter, but EPA can assure that any future population which comes into contact with the Site will not be adversely impacted.

68. COMMENT: One representative from the Washington and North Idaho District Council of Labor voiced concerns about the health and safety of site workers participating in the cleanup operation. He expressed the opinion that Hydrometrics has demonstrated continuing disregard for worker safety and health concerns by allowing contaminated vehicle/equipment rinse water to be discharged directly into Commencement Bay via storm sewers.

RESPONSE: EPA requires Asarco to submit health and safety plans for all of the cleanup activities that occur on the Site. During any cleanup activities, EPA has an oversight contractor on site to ensure that the work plans and the health and safety plans are being followed appropriately. Any concerns about worker safety should be forwarded directly to the Washington Department of Labor and Industries. See also Response to Comment No. 22. During soil excavation and disposal activities, EPA will require Asarco to control discharges of contaminated water.

69. COMMENT: The Puyallup Tribe requested that EPA take into consideration their hunting, fishing and other subsistence activities on and near the Puyallup Reservation and added that the living resources in Commencement Bay and human population that depends on these resources must not be subject to the bioaccumulation of hazardous chemicals. The Puyallup Tribe also stated that the protection of anadromous fish (species which live in fresh and salt water), on which much of the tribe relies for spiritual subsistence and economic survival, is of paramount importance. The Tribe requested that EPA conduct a fish consumption study prior to issuing the ROD for the smelter cleanup.

RESPONSE: EPA has not evaluated how much fish from Commencement Bay is consumed by the Puyallup Tribe in making its cleanup decisions in this ROD. EPA has agreed, however, to consider this information when making its cleanup decision regarding groundwater.

EPA is and will continue to take into account the concerns of the Puyallup Tribe, which encompass the existence of contamination in all of Commencement Bay, not just that associated with the Asarco Site. EPA has set its cleanup goals at levels which it believes are protective of human health and the environment. Because `protectiveness' includes minimizing contamination in fish that may be consumed by humans, EPA is particularly focusing on contaminant levels in fish in its continued investigation of marine sediments off-shore of the Site.

70. COMMENT: Two commentors felt that the health risks associated with the contamination of the Asarco Site may be exaggerated because they have not experienced adverse health effects from living near the Site. One commentor suggested that stress from the cleanup process is probably more debilitating than the arsenic contamination, and the other commentor expressed the opinion that EPA should offer a real-life comparisons of the alleged increased health risks from exposure to lead and arsenic.

RESPONSE: The potential health risks that have been identified at the Site in the Risk Assessment are primarily based on predicted adverse effects posed by current Site conditions to potential residents, workers, recreational visitors or trespassers, i.e., people who may spend varying amounts of time at the smelter in the future. Because residents, workers, etc. are not living/working/playing on the Site now, it is not possible to give real-life examples. The evaluation of potential increased health risks from lead and arsenic are summarized in Section 4.2 of the Risk Assessment (Kleinfelder, 1993).

Residential:

71. COMMENT: One person questioned whether or not it is safe to eat home grown produce from the area.

RESPONSE: The Risk Assessment conducted for the Ruston/North Tacoma Study Area indicated that the risk from eating fruits and vegetables that are grown in the area is very small. Precautions which are recommended by the local health department include, thoroughly washing leafy produce such as lettuce, and produce which is grown underground, such as carrots and radishes.

72. COMMENT: One person expressed the opinion that Asarco has been given "special

treatment" because the level of arsenic and lead contamination that it has been ordered to excavate is greater than the Action Levels established by the State.

RESPONSE: EPA believes this commentor is referring to action levels for the residential area EPA disagrees that Asarco has been given "special treatment." EPA has selected safe cleanup levels for the soils. Decisions regarding the cleanups of both the Ruston/North Tacoma Study Area and the Smelter Site, including the specific determinations of action levels, have been made in accordance with federal and state requirements, and with the concurrence of the Washington Department of Ecology.

2.10 DEVELOPMENT/LAND USE

73. COMMENT: Numerous commentors expressed specific opinions regarding the development that should occur at the Asarco Site after cleanup. One person commented that, if the Asarco Site is beautified, surrounding property values would be elevated and residents would be angered by the resulting increase in property taxes. One commentor expressed the opinion that Asarco is living up to the public trust by their commitment to invest 15 to 20 million dollars beyond the cleanup cost to encourage future development. Another person commented that redevelopment would not compensate for the legacy of pollution that Asarco will leave behind.

RESPONSE: All of the comments received by EPA regarding future development will be forwarded to the Land Use Group which includes representatives from the City of Tacoma, the Town of Ruston, the Metropolitan Park District and Asarco. EPA believes that the cleanup of the smelter site will reverse the legacy of pollution from the operation of the smelter. EPA is not in the position to evaluate the potential for property taxes to change based on Site development activities.

74. COMMENT: Many commentors were concerned that only financial benefits, and not environmental and/or long-term human health considerations, have been considered in the Master Development Plan. Two of these commentors expressed the opinion that the development plan was designed primarily to enable Asarco to save significant cleanup costs. One person commented that when a company pollutes an area so badly it achieves the distinction of worst Superfund site, a cursory cleanup for the sake of profit and added local taxes does not meet the intent of Superfund legislation.

RESPONSE: EPA has selected cleanup measures that will comprehensively address contamination at the Site and that are fully in accordance with the Superfund law. Further, the primary intent of the Master Development Plan is to provide for future development of the Site once cleanup has been completed. Accordingly, other than the need to maintain the protectiveness of the cleanup measures, it is reasonable that the Master Development Plan not focus on environmental considerations.

75. COMMENT: Several commentors suggested that development would hinder remediation of groundwater and surface water and restoration of natural habitat and that development should not be allowed until that portion of the Site is fully remediated. One commentor suggested that the cleanup be modified to include a provision that development may not hinder remediation or restoration, and another commentor stated that development should not occur until the effectiveness of a permanent remedy is clearly established for surface water, groundwater, and sediments.

RESPONSE: The selected remedy requires that development activities not interfere with potential cleanup activities, including the possibility that surface water and/or groundwater treatment will be necessary in the future (see Sections 9.3 and 9.5 in the ROD).

76. COMMENT: Two commentors requested that Asarco separate the cleanup effort from the commercial development of the Asarco site; one of these commentors requested that Asarco acknowledge this separation publicly.

RESPONSE: These two processes are separate but contain common elements: EPA is determining the environmental cleanup of the Site. The local municipalities and Asarco will be facilitating the development of the Site.

However, EPA and the other parties involved recognize the advantage of combining some of the planning elements for future development with the design of site cleanup activities. For example, if Asarco and the local governments can identify the type and locations of development (number of people, type of services necessary) then it can design the water, sewer, electricity and phone lines at the same time Asarco and EPA are designing a cap for the Site. This will allow the cap, with the necessary utilities, to be installed at one time rather than installing the cap and digging it up later to install utilities.

77. COMMENT: Two people commented that if Asarco conducted the cleanup and did not have enough money left over for development, the Asarco Site' would be redeveloped anyway because it is prime valuable property. Two people added the comment that a pollution free site and community would be the biggest asset to encourage development in the area, and another commentor suggested that Asarco will redevelop the Site based on economic reasons alone, regardless of any "Principles of Agreement" with the local communities. One commentor expressed the opinion that the property would be more valuable if there was not an OCF on the Site.

RESPONSE: By signing the "Agreement in Principle," Asarco and the local governments committed to using their best efforts to develop the property. EPA hopes that all of these parties will honor their commitments and that the former smelter will be returned to productive uses for the community. EPA has no opinion on whether the Site would be redeveloped if Asarco had insufficient funds.

78. COMMENT: The Town of Ruston commented that an important element necessary for future development is EPA providing an appropriate release indemnification from liability for Ruston, Tacoma, the Park District, the Public Development Authority, and future lessees and lenders.

RESPONSE: At the national level, EPA Headquarters is committed to encouraging development and reuse of Superfund sites. National policies and guidance regarding such matters, including the potential liability associated with Superfund sites, are being revised. EPA Region 10 will work with Headquarters' policies and guidance to provide as much certainty to potential owners, investors and tenants at the Asarco Site as possible.

79. COMMENT: The Town of Ruston commented that the design and implementation of remediation must support the Master Development Plan by allowing appropriate areas of the Asarco Site to be cleaned in a timely manner, thus opening these areas to development prior to completion of the remediation of the entire Site.

RESPONSE: EPA's intent is to allow development of the Site in a timely manner. However, EPA's primary concern is the safety and well-being of the site workers, surrounding residents and any potential future users of the Site. Development activities will be allowed to proceed when it is certain they will not interfere with cleanup of the Site.

2.11 COSTS

80. COMMENT: Several commentors expressed the opinion that Asarco has made great financial gains at the expense of the environment and should be held financially accountable for a thorough cleanup. One commentor expressed the opinion that the revenue generated by Asarco during its operation and the revenue that will be generated after development will far exceed the cost of any cleanup.

RESPONSE: Under the Superfund law, Asarco is liable to perform (or pay for) the cleanup selected by EPA. The cleanup must attain specific statutory mandates, including protection of human health and the environment. The amount of money that may have been generated by Asarco while the smelter was operating (or could be generated after cleanup) does not influence the extent of cleanup necessary to be protective and therefore is not considered by EPA when selecting a cleanup.

81. COMMENT: Several commentors indicated that the extra cost for treatment of the contaminated soils should not be a factor in determining the best cleanup alternative.

RESPONSE: One of the requirements for cleanups selected under the Superfund law is that they are cost-effective. EPA uses several factors to determine whether cleanup measures are cost-effective, including comparing the relative costs and effectiveness of various cleanup alternatives. Based on EPA's analysis and review of the comments received, EPA believes that the additional "effectiveness" provided by treating soils is not worth the increased cost compared to disposing soils in an OCF.

82. COMMENT: One commentor posed two cost-related questions: How much will it cost to treat the soil and store it in an OCF, and how much will it cost to clean the aquifers?

RESPONSE: EPA estimates that it would cost $70 million to treat source area soils, dispose the treated soils in an on-site solid waste landfill, and dispose the demolition debris in an off-site hazardous waste landfill. (This option is approximately $20 million more than soil treatment/disposal beneath the Site cap and $47 million more than soil disposal without treatment and debris disposal in the OCF.)

Asarco has estimated that the cost of pumping and treating groundwater for 2 years and 30 years at $15.6 million and $20.1 million, respectively. Using an in-situ (in place) groundwater treatment method would cost $1.3 million and using in-situ groundwater treatment by seawater injection would cost $1.5 million for 30 years. Given the uncertainty of whether these groundwater measures would be effective in cleaning up the aquifers, EPA has determined that it is appropriate to take the source control measures identified in the selected remedy and then evaluate what, if any, further groundwater cleanup activities are necessary.

83. COMMENT: One citizen expressed the opinion that the billions of dollars spent on the Superfund program in the U.S. is disgraceful and has shown very few results.

RESPONSE: EPA disagrees. Accomplishments under the Superfund program include performing thousands of short-term removal actions (e.g., responding to emergency spills, etc.), completing major cleanup construction activities at over 278 sites, and starting major cleanup activities at more than 430 sites.

84. COMMENT: One commentor expressed the view that millions of dollars have already been wasted trying to determine the best cleanup method for the Asarco Site.

RESPONSE: EPA and Asarco have spent significant time and money to determine the types and locations of contamination on the Site and how the Site can be cleaned up. These evaluations are necessary and worthwhile and will result in an efficient cleanup.

85. COMMENT: One commentor expressed the opinion that Asarco should have been responsibly setting aside money for cleanup every year since the Site was deemed to be part of a Superfund site. Another commentor stated that Asarco had a savings account for contamination cleanup in excess of $150 million dollars.

RESPONSE: Asarco will be required to fund the amount necessary for cleanup of the Site. How Asarco chooses to pay for the cleanup is its own decision.

86. COMMENT: One citizen was dismayed at the amount of money Asarco was spending on its public relations campaign, stating that the money spent sending her leaflets, correspondence, and Christmas cards would be better spent on cleanup of the Asarco Site.

RESPONSE: EPA will not credit or deduct the amounts Asarco has spent on public relations campaigns from the amount it will be required to spend on cleanup.

2.12 PUBLIC INVOLVEMENT

87. COMMENT: Many commentors expressed the opinion that Asarco is trying to pressure the public into accepting the provisions of the "Agreement in Principle," including the less expensive on-site containment option, in exchange for development money. Two commentors suggested that Asarco has "bought off" the officials from Ruston, Tacoma, the Park Board, and other community agencies. Another commentor expressed frustration with Asarco's "carrot and stick" tactics to keep contamination on the Site and requested that EPA weigh-in on the side of the public when making decision. One of these commentors suggested that there will be a lot of alienation against the EPA if the OCF is not approved.

RESPONSE: EPA believes that the community participation in planning for the future development of Site was important and beneficial to the community. The local governments and

Asarco succeeded in providing many sessions for community members to express their point of view and then took their comments and used them to develop an overall design strategy for the project.

It appears that one reason Asarco spent a lot of time and money on the development project was in hopes that a less expensive cleanup option would be supported by the community. For the past 4-6 years elected representatives of the community had been strongly opposed to an OCF. During the land development sessions, the facilitators were able to understand what the objections and concerns were about on-site disposal and were able to design a preliminary development plan to address these objections and concerns.

Asarco's efforts were very public, as was the approval of the "Agreement in Principle," by the councils in Ruston and Tacoma, and the Park Districts' board. The local governments recommended to EPA that an OCF be selected. The charge that Asarco has "bought off" public officials is unfounded. During the public comment period, EPA received approximately 830 out of a total of 900 cards and letters of support for an OCF and future development. EPA shares the opinion of these commentors that an on-site containment facility can be constructed to protect human health and the environment.

Independent of the land use community participation sessions, EPA sponsored 2 public meeting and spoke at 10 meetings with local community groups such as the Rotary Club and the Environmental Commission of the Chamber of Commerce. The overwhelming message heard at all of these meetings was support for on-site disposal of soil and debris.

88. COMMENT: Several people commented that the EPA should make the best and safest cleanup decision possible, without public influence, pressure from the land use committee and/or development considerations. Some of these commentors suggested that the propaganda and development money offered by Asarco may be tainting the approach by the federal government to the cleanup and that EPA should keep these considerations separate from the cleanup decision. One commentor was disturbed by Asarco's seemingly "manipulative" pamphlet. Conversely, two commentors expressed the opinion that the EPA use a more democratic process to decide the cleanup method for the Asarco Site and give greater consideration to public opinion.

RESPONSE: Public comment on EPA's cleanup decision is an important part of the remedy selection process. In this case, EPA encouraged the land use process to occur prior to issuance of EPA's Proposed Plan in order for the agency to fully understand the needs of the community and not preclude future development options needlessly. Nonetheless, EPA's paramount concern is protection of human health and the environment, which will be achieved by the cleanup remedy that EPA has selected for the smelter site.

89. COMMENT: Several commentors commended Asarco, the municipalities, and the community for coming together to work on a major urban revitalization plan. Some commentors stated that this project is a demonstration of how EPA can work with the community to promote environmental remediation and economic development.

RESPONSE: Although we are not done yet, EPA is also pleased with the work the Land Use Group has completed and believes that working on Site cleanup together with future development of Superfund sites is an effective approach.

90. COMMENT: One citizen would like to know what she can do to help, and which politicians have expressed concern or provided assistance.

RESPONSE: There will be many opportunities for community involvement during the development of the environmental cleanup design work plans. EPA will send out Fact Sheets that describe ongoing work and also provide notice of opportunities for the public to participate. In addition, EPA anticipates that the Land Use/Development Group will continue to sponsor community sessions in order to refine the uses for the "development zones."

Many of the elected and appointed representatives of Ruston, Tacoma and the Park District have been involved in the land use and cleanup processes, such as:

Phil Parker, Mayor of Ruston
Charlene Hagen, Ruston Town Council
Ray Corpuz, City Manager of Tacoma
Paul Miller, Tacoma City Council
Jim Montgomerie, Metropolitan Park District

91. COMMENT: One person was dismayed by the course of events at the Pierce County Council meeting because she felt that the environmental aspects of the cleanup were not adequately addressed, only development and financial topics were discussed in detail. She also expressed the opinion that most of the people in the community are not adequately informed of EPA's cleanup proposal.

RESPONSE: EPA was not notified of the County Council meeting. EPA uses various ways to keep the public informed, such as Fact Sheets, public meetings, news ads, mailing lists, TAG Grants and information repositories. We are always open for any suggestions, so please let us know of your ideas. EPA believes that by the end of its 90-day public comment session and the Asarco Week #4 meetings that hundreds of local community members were aware of and had participated in the cleanup and planning decisions for this Site.

2.13 MISCELLANEOUS

92. COMMENT: One commentor believes that the following statement is not complete and does not address the other characteristics of dangerous wastes as defined in Washington State Dangerous Waste Regulations (WAC 173-303): "Waste that is not a federal hazardous waste but has the potential to migrate into the environment would be disposed in a solid waste landfill that meets state requirements (Page 23, Paragraph 5 of the Proposed Plan)." He asked if the Toxicity Characteristic Leaching Procedure (TCLP) is the only criterion that was used to make the determination.

RESPONSE: The statement in the Proposed Plan was intended to clarify that soils not regulated under federal law (e.g., treated soils that pass the TCLP test) may still need to be disposed in a landfill that met state solid waste landfill requirements. This determination would have been based on the results of water leaching tests showing that disposal of treated soil would not be protective of the environment. The state has specified its requirements for disposal of dangerous waste in WAC 173-303. The state's determination of "dangerous waste" can be based on metal concentration as well as TCLP leachate concentration.

EPA has selected the OCF, the untreated soils that will be disposed on site are a federal hazardous waste. Therefore, the OCF will meet both federal and state hazardous and dangerous waste requirements for landfills.

93. COMMENT: One person suggested that Asarco has profited at the expense of the environment because of the lack of environmental concern on behalf of the local governments. This commentor stated that the "Tacoma Aroma" is symbolic of the way the local governments have been dominated by industry. This commentor added the example of the local water treatment plant that has been in violation of EPA standards for years, however the city has chosen to pay the fine rather than remedy the problem.

RESPONSE: EPA encourages the commentor to express his/her views directly to the appropriate local governments.

94. COMMENT: Several commentors expressed the opinion that the EPA has done a good job in its development and presentation of the preferred alternative and Proposed Plan.

RESPONSE: EPA appreciates the comment.

95. COMMENT: Several public agencies, the Washington Department of Natural Resources, Citizens for a Healthy Bay, and the Puyallup Tribe commented that they would like to have greater involvement and input in the development and planning of the Preferred Alterative/ Proposed Plan. Additionally, the Puyallup Tribe requested that EPA act in concert with Federal Indian Policy and consult with the tribe on whether the Proposed Plan is consistent with Environmental Justice policies.

RESPONSE: All of these organizations participated on the Coordinating Forum (local, state and federal representatives with an interest in the Asarco Smelter project) which was convened in July 1993. Policy makers and staff members from local government, local, state and federal health departments, and environmental representatives participated in all aspects of reviewing and commenting on the cleanup alternatives and future land use concepts. EPA will encourage these same organizations to participate in remedial design.

Consistent with EPA's Indian Polich, EPA's Regional Administrator met with representatives of the Puyallup Tribe on March 16, 1995, to consult on a government-to-government basis on all of the Tribes concerns. EPA believes that the Proposed Plan is consistent with its regional, Environmental Justice principles.

96. COMMENT: The Puyallup Tribe reiterated the Clinton Administration's policy that "people of color and the economically disenfranchised should not be forced to bear unfair environmental burdens" (Executive Order 12898, Federal Register 7629).

RESPONSE: EPA believes that the cleanup it has selected is fully in accordance with the objectives and requirements of Executive Order 12898.

97. COMMENT: Several commentors were troubled by the estimated time for completion of the cleanup. They believe that the cleanup action has taken too long already and/or that the cleanup process and consequent development should be expedited. Other commentors requested EPA to take time to carefully consider public comments and to make scientifically sound decisions.

RESPONSE: EPA has reviewed all of the comments received during the public comment period. It is EPA's intent to work with Asarco and the local municipalities so that cleanup activities can begin as soon as possible. One approach to ensure that Site cleanup will not be delayed is that when the Site is ready to be capped, even if all of the residential soils from the surrounding neighborhoods have not been removed, a cap will be installed and the Ruston/North Tacoma soils will be disposed in an appropriate off-site disposal facility, see Section 9.0 of the ROD.

98. COMMENT: One commentor expressed concern about the noise that the cleanup project would generate.

RESPONSE: Heavy equipment and machinery will be used during the cleanup but EPA will require Asarco to reduce the noise to the extent possible by limiting the work hours and selecting dedicated routes that trucks and traffic can use. Local residents and government will have an opportunity to participate in the development of these plans.

99. COMMENT: One commentor believed that the stack bricks would be removed after demolition, however was surprised to learn that they would only be covered with dirt.

RESPONSE: The stack bricks were covered with dirt after the stack was demolished in January 1993. However, the selected remedy calls for these bricks to be unburied and permanently disposed in the OCF.

100. COMMENT: The Puyallup Tribe commented that the nine criteria used to analyze the alternatives should not all be given equal weight. They stated that the protectiveness of human health and the environment and compliance with ARARs are the most important threshold criteria.

RESPONSE: Section 8.0 of the ROD explains how EPA evaluated the cleanup alternatives using the nine criteria. EPA emphasizes the importance of protectiveness and compliance with ARARs by designating them as "threshold criteria." This means that an alternative was not evaluated further if it did not meet these criteria.

101. COMMENT: One commentor expressed the opinion that, given the hazardous waste sites for which Asarco may also be responsible for in Montana and Colorado, Asarco is the fifth worst polluter in the country and possibly the world. This commentor also expressed the opinion that "Asarco's long-standing policy appears to be coverup and not cleanup."

RESPONSE: Asarco will be held responsible for cleaning up the former Asarco Tacoma smelter as well as other sites.

102. COMMENT: One commentor expressed the opinion that Asarco should have been forced to clean up and redevelop the Site years ago, and that Asarco has needlessly delayed clean up and redevelopment of the Site through endless litigation.

RESPONSE: Actually, to date there has not been litigation associated with the cleanup itself. Since 1986, EPA and Asarco have focused on the investigation of the Site, the analysis of potential cleanup alternatives, and the demolition of smelter buildings and structures.

103. COMMENT: One person commented that the cleanup method and development plan are irrelevant as long as his commute to work is not affected, and the new development is clean, legal, and profitable.

RESPONSE: EPA believes that the cleanup method and development plan are very relevant to the future of the community overall. EPA notes, however, that the community should expect that roads around the smelter may need to be closed during parts of the cleanup.

104. COMMENT: One commentor requested that the public comment period be extended past the October 11, 1994, deadline.

RESPONSE: The public comment period was extended to November 10, 1994, based on citizens' requests.

105. COMMENT: One commentor requested that interested parties be provided with a straightforward comparison between EPA's preferred alternative and the alternative proposed by the land use committee.

RESPONSE: The majority of the cleanup activities identified in EPA's selected cleanup remedy are also identified in Paragraph 7 of the "Agreement in Principle. However, EPA's selected remedy, see Section 9.0 of the ROD, provides more detail than the "Agreement in Principle" as to why many of the cleanup measures are necessary. Both the "Agreement in Principle" and the Selected Remedy require the cleanup to be protective of human health and the environment over the long term.

Common Elements of the "Agreement in Principle" and EPA's Preferred Alternative.

- Utilization of Ruston/North Tacoma residential soils as the sub-base for the plant and breakwater (slag peninsula) cap
- Monitoring and institutional controls
- Abandonment of the production well
- Installation of groundwater/surface water interceptor trenches
- Replacement of the existing drainage system, including outfalls
- Shoreline armoring

Additional Elements of EPA's Proposed Plan.

- Treatment of source area soils by solidification/stabilization and disposal as a sub-base to the site-wide cap
- Demolition of remaining buildings and structures
- Mitigation measures if wetlands or intertidal habitat are adversely impacted by cleanup activities
- Safety measures
- Integration of cleanup with land use plans

It should be noted that EPA's Selected Remedy in the Record of Decision selected disposal of soil without treatment in an OCF rather than soil treatment with solidification/stabilization. The "Agreement in Principle" also identified disposal of soil without treatment in an OCF. Other elements of the Selected Remedy are very similar to the elements in the Preferred Alternative described above.

106. COMMENT: One Metropolitan Park Board member commented that he did not sign the "Agreement in Principle" because he did not have the opportunity to fully analyze the situation and he was pressured, lied to, and threatened. He also stated that the Metropolitan Park Board has not agreed, passed, or discussed the "Agreement in Principle," nor have they authorized any

letters to be directed to EPA.

RESPONSE: EPA's understanding is that the Metropolitan Park Board did pass and sign the "Agreement in Principle" with all but one supporting vote. EPA suggests that this member talk directly with fellow Board members.

107. COMMENT: One commentor expressed the opinion that, based on the information on page 13 of EPA's Proposed Plan, it appears that all of the approaches are protective of public health and the environment and that it is difficult to determine which options are truly protective.

RESPONSE: On page 9 of the Proposed Plan, EPA provided all of the cleanup alternatives that were considered. On page 21, EPA explained that "the no-action alternatives are not protective of human health and the environment and thus were not further evaluated under the nine criteria." Otherwise, EPA believes that any of the remaining alternatives (other than monitoring and limited action) would have been protective of human health and the environment.

108. COMMENT: The Town of Ruston requested that EPA respect the permitting processes of the local governments (Ruston, Tacoma, Park District) and not preclude or usurp their authorities to require Asarco to obtain any and all infrastructure permits, and that these municipalities would like to review remediation plans.

RESPONSE: EPA agrees that it is important to work within the established permit processes of the local governments. EPA's expectation, however, is that these processes will not result in delays to cleanup activities.

3.0 ASARCO'S COMMENTS AND EPA RESPONSES

As part of an effort to obtain public comment regarding the Master Development Plan, Asarco distributed self-addressed, postage-paid comment cards to the public at several community meetings. Two different card types were distributed by Asarco during this effort, the first batch of cards were entitled, "Tell EPA what you think of the Asarco Land Use Plan," and included the statement, "I want the Asarco Site redeveloped," the second batch of cards were entitled "Tell EPA You Support the Asarco Master Development Plan," and included two statements to select from: "I support development of the Asarco Site and the on-site containment facility" and "I would like additional information about the plan and community meetings." Additional space was provided on both cards to include comments and the respondent's address/phone number.

A total of 673 comment cards were forwarded to EPA by Asarco during the public comment period. Based upon the type of comment card and the nature of the reply received, EPA has tallied and separated the cards into the five following general categories with regard to cleanup preference:

- 547 comment cards were marked in favor of the development of the Asarco Site including an on-site containment facility.
- 69 of the comment cards, respondents offered specific comments and suggestions for development of the Asarco Site, but not a preferred cleanup method.
- 24 of the comment cards, respondents indicated that they would like additional information and/or expressed specific questions, but did not state a cleanup preference. The questions have been summarized and responded to in Section 2.
- 19 respondents indicated that they were either opposed to the OCF or suggested a combination of on-site containment and treatment.
- 14 of the comment cards, respondents offered miscellaneous suggestions and comments, but did not indicate their cleanup preference.

EPA notes that many individual commentors sent their letters and "reply cards" directly to EPA and that most of these commentors also stated they were in favor of future development and an OCF.

In addition to comments received from citizens, local officials, and Natural Resource Trustees, EPA received comments from Asarco, Inc., the Potentially Responsible Party for this Site. The comments below summarize Asarco's overall concerns as well as its specific technical concerns with the Proposed Plan. As a member of the Land Use Group, Asarco did not support EPA's Preferred Alternative of soil treatment based on cost, long-term effectiveness and because it believes that treatment would preclude the implementation of future land development plans.

GENERAL COMMENTS

1. COMMENT: Asarco believes that although the cleanup decision is separate from the plans for future use of the Site, that the terms of the "Agreement In Principle" should be a significant factor to modify EPA's remedy when using the nine criteria analysis. Asarco believes that even if soil treatment and on-site containment facility (OCF) were "equal" with respect to the threshold and balancing criteria, that the community support for and on-site containment should compel EPA to select and OCF.

RESPONSE: As a modifying criteria, community acceptance, could result in EPA favoring a feasibility study that was otherwise equal with respect to all of the other threshold and balancing criteria. As stated in the Proposed Plan, EPA recognizes that in addition to cleaning up contamination at the Asarco Site, that the community is very interested in Site development as well. As a result, EPA received numerous comments from community members, community leaders and local businesses and groups supporting an OCF and future site development. It was these comments, in addition to the "Agreement in Principle," that convinced EPA that the selection of the OCF would be the best cleanup remedy.

2. COMMENT: Asarco stated that on-site containment meets both of the threshold criteria described in the "nine criteria:" (1) Protection of human health and the environment and (2) all Applicable and Relevant and Appropriate Requirements (ARARs) and on-site containment facilities (OCFs) have shown their effectiveness over the long term at sites throughout the country.

RESPONSE: EPA agrees that either soil treatment or on-site soil containment meet the two threshold criteria and that an OCF can be designed to be protective over the long-term.

3. COMMENT: Asarco stated that EPA's Proposed Plan is not "cost-effective," nor does it "utilize a permanent solution and alternate treatment technologies or resource recovery to the maximum extent practicable" which are two of five balancing criteria described in the "nine criteria." Asarco believes that cost-effectiveness is a "condition (emphasis added) for remedy selection, not merely a consideration during remedial design and implementation," (55 F. Reg. 8726), and that "cost-effectiveness" is based on the selected remedy's overall effectiveness which is described in § 300.430 (f)(1)(i)(B) of the National Contingency Plan (NCP) as long-term-effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, and short-term effectiveness.

RESPONSE: EPA has made a determination in the ROD that disposal in the OCF is the cost-effective remedy (see section 10.3 of the ROD). This determination is based on EPA's finding that disposal in an OCF is an effective approach for isolating soil and debris from the environment and because disposal in an OCF is estimated to cost nearly $30 million less than treatment of soil. In addition, the community clearly stated that it believed that selecting an OCF would allow future development opportunities at the Site.

4. COMMENT: Asarco also stated that increased cost of treatment would not result in a commensurate decrease in risk at the Site.

RESPONSE: EPA believes that the primary issue raised by the choice between treatment and soil was not the reduction in risk, which would be comparable, but the ability to select a remedy that would remain protective over the long-term and be compatible with future plans for the Site.

5.COMMENT: In addition, Asarco identified several additional reasons why soil treatment should not be selected. These reasons are:

- there is no evaluation of the effectiveness of treatment over many years;
- the cost of treatment is prohibitively high ($150/ton);
- the amount of additive required results in a low density product resulting in a significant increase in volume of treated material;
- the physical properties of the treated material raise implementability questions with respect to future plans for Site development; and
- the longer time for remediation would have serious negative effects on future land use plans.

RESPONSE: EPA's response is as follows:

(1) EPA agrees. Although as noted in Response No. 21 in Section A, landfills have also not been around for a significant number of years either. (2) The cost of treatment, re-evaluated in context of the responses received from the community, indicated that a less costly and equally protective cleanup was preferred. (3) Although it is not clear how/if the increased soil volume would have impacted Site development, EPA believes that this could have been factored into Site plans in the future. (4) EPA agrees that the appropriate places on the Site would have had to have been identified to ensure. comparability of soil treatment with Site development. (5) EPA is not sure why Asarco believes that soil treatment would take longer than construction and filling an OCF. The Feasibility Study states that treatment would take 6 months and the OCF alternative could take up to 2 years.

6. COMMENT: The overwhelming community support for the "Agreement in Principle" should result in the selection of a containment alterative as the remedy and the NCP allows EPA to select an alternative favored by the community over an equally protective alterative.

RESPONSE: EPA has selected an OCF as part of its selected remedy, see Section 9.0 in the ROD.

7. COMMENT: The ROD should acknowledge the work currently being conducted under the Administrative Order on Consent which was signed by EPA and Asarco in 1994, and allows maximum future flexibility in any modifications to the current shoreline so that the uplands and marine remedial actions can be integrated in a reasonable and cost-effective manner. In addition, Asarco stated that CERCLA does not authorize EPA acting alone to impose habitat restoration or mitigation as part of a remedial action, but instead, states that restoration measures may be agreed upon by the PRP and the natural resource trustees.

RESPONSE: EPA acknowledges that sampling and analysis activities are being conducted under the 1994 AOC. Integration of the cleanup of sediments and cleanup of uplands portions of the Site is a worthwhile objective but is not a specific provision of the AOC. During the development of the work plans for Site cleanup, EPA will work in conjunction with Asarco, the natural resource trustees and the community to develop the necessary mitigation measures for the Site, see Section 9.0 of the ROD. EPA agrees that restoration measures (i.e., to compensate for past injuries to natural resources) will be determined by Asarco and the natural resource trustees.

8. COMMENT: The ROD should resolve the issue of the Ruston/North Tacoma Study Area residential soils disposal and should set performance standards, rather than numerical remediation goals, for groundwater monitoring.

RESPONSE: The selected remedy for the Ruston/North Tacoma residential soils is to place them beneath a cap (e.g., used as a sub-base) in areas that will not be impacted by groundwater, see Section 9.0 of the ROD. The ROD identifies measures to control the sources to groundwater (e.g., soil excavation, containment and capping and replacing the surface water drainage system) and monitors the effect of these activities. The Class III preliminary remediation goals will be used as bench marks to evaluate the impact of source control activities on groundwater that enters Commencement Bay.

9. COMMENT: There are some fundamental differences between EPA's preferred remedy and the remedial actions proposed as part of the Agreement in Principle. The primary differences involve how soil is handled after excavation from source areas.

RESPONSE: EPA has selected disposal of source area soil in an OCF in the Record of Decision.

10. COMMENT: Treatment of a portion of excavated soils, the arsenic kitchen soils for

example, would be prohibitively costly.

RESPONSE: EPA believes that treatment of any part of the excavated soils before disposal in an OCF would certainly add to the overall cost of the cleanup. Because several commenters recommended that some or all of the soils be treated before placing them in an OCF, EPA evaluated the environmental benefits of treatment. In this analysis, see Appendix D, EPA has determined that treatment of the most contaminated source area soils would not substantially decrease the potential impact on groundwater from leachate. EPA has not selected treatment of soils as part of the ROD.

11. COMMENT: Over 70 physical, chemical, biological and thermal treatment processes were examined for potential application for the smelter site. Among the technologies investigated for site specific applications for the site were soil washing, soil acid leaching, and soil fixation.

The studies showed that soil washing and/or leaching was not applicable for the site because of difficulties with physical and chemical conditions of site soils. Technical problems with soil leaching included incomplete removal of arsenic, failure of leached or washed materials to pass TCLP after treatment, and additional treatment requirements associated with acid fluid treatment and subsequent disposal.

Two commercial vendors were able to demonstrate, in the short term, attainment of treatment objective. However, projected treatment costs are high and considerably more expensive than other soil options including the use of an OCF.

RESPONSE: EPA believes that soil treatment by solidification/stabilization could be effective over the long-term. The additional studies conducted by Asarco indicate that the TCLP test results are slightly less effective after 28-day testing (but are still significantly below hazardous waste regulatory threshold levels for treatment) and that the volume of the treated material increased by approximately 60%. EPA did not select treatment, however, because soil can effectively be isolated in an OCF, the OCF was much less expensive than treatment, and because the majority of commenters supported disposal in an OCF in conjunction with land use plans.

SPECIFIC COMMENTS

All of the following comments from Asarco refer to EPA's Proposed Plan, dated August 10, 1994.

12. COMMENT: Page 4, fourth paragraph, first sentence. The sentence should read "surface water features on the smelter property include surface water in the cooling pond...." There is no longer surface water flow into the pond and surface water flow has been diverted around the cooling pond since Spring 1993.

RESPONSE: This comment has been incorporated into the "Background" section of the ROD and it now states that, "Surface water features on the smelter property include surface water in the cooling pond..."

13. COMMENT: Page 5, legend to Figure. "known sources" should be changed to "identified source areas"

RESPONSE: The clarification has been made in revised Figure 1-1.

14. COMMENT: Page 6, first paragraph, last sentence. The remedial investigation identified six areas as source areas of arsenic and metal concentrations to groundwater, based primarily on the association of these areas with elevated concentrations in groundwater. Of these areas, the arsenic kitchen and the southeast plant area have subsurface soil data that support the hypothesis that these areas contribute arsenic and metals to groundwater. The stack hill contributes arsenic and metals to surface water where groundwater "daylights" through soils that contain elevated arsenic and metals. Available soil and water data from the cooling pond suggest there are little impacts to groundwater, from this source; however, the pond is considered a source area because of its total sediment arsenic and metal concentrations and because of its historic use as a process water pond that stored water containing elevated arsenic and metals. The remaining areas (copper refinery area and fine ore bins area) are assumed groundwater

sources primarily because of their association with elevated groundwater concentrations and known history of these facilities. Soils in these areas were assumed to be sources to groundwater for feasibility study purposes; however, insufficient data are available to positively establish soils from these areas as groundwater arsenic and metal sources.

The sentence would be more representative of actual site conditions if it read "These are areas that appear to act as the primary sources".

RESPONSE: The ROD states that, "These are areas that have either the highest measured concentrations of contaminants in the soils, appear to act as the primary known sources of contamination to groundwater and surface water, and/or have large amounts of contaminated material based upon the historic uses of these areas."

15. COMMENT: Page 6, second paragraph, first sentence. The first sentence is not true. First, the areas have not been identified based on the presence of the "highest known concentrations" but, instead, based on their association with highest groundwater concentrations of arsenic and metals. In some cases, such as the arsenic kitchens and stack hill areas, these areas do contain some of the highest total soil metal concentrations, but, more importantly, also the highest leachate soil concentrations. However, some of the identified source areas are not associated with confirmed total soil data. For example, to date the soil quality underneath the fine ore building has not been tested. Second, not all metals and/or organic chemicals are "highly mobile and leaching out of soils or slag." The sentence should be changed from "...which are highly mobile and are leaching out of soils or slag..." to "...which may be leaching out of soils or slag..." Also, the suggestion that high metal values automatically result in principal threats to groundwater is not correct. High metal values in themselves are not an indication of a threat to groundwater, as demonstrated by slag. The threat to groundwater is determined by leachability and subsequent mobility of a chemical.

RESPONSE: See response to Comment No. 14.

16. COMMENT: Page 6, fourth paragraph, last sentence. The statement that, "Most of the slag portions of the Site appear to contribute less contamination... as compared to the source areas..." is incorrect. All slag contributes less than the source areas. However, this effect can be obscured by other sources, such as is the case for the slag located in the plume down-gradient from the arsenic kitchen. It would be representative of actual conditions if this sentence was changed to read: "Slag appears to contribute less metals to groundwater...as compared to the source areas..."

RESPONSE: The ROD states that, "The slag portions of the Site appear to contribute less contamination to groundwater as compared to the source areas described."

17. COMMENT: Page 6, sixth paragraph, second sentence. It is not certain pipes are filled with sediment or that they are cracked. Because of the age of the plant, an assumption was made in the FS that drainage lines were cracked and that sediment in pipes was possible. A suggested change to the sentence is "pipes may be cracked and/or contain contaminated sediment."

RESPONSE: The ROD states that, "The pipes and drains associated with the system may be cracked and/or the pipes filled with contaminated sediments."

18. COMMENT: Page 6, ninth paragraph, last two sentences. Based on site data, it is apparent that smelter site groundwater arsenic and metals are more affected by low redox conditions associated with the presence of organic material than by resultant pH conditions. The presence of seawater apparently buffers groundwater in the southeast plant area and pH concentrations are typically above 8 indicating acidic conditions at this location are not occurring.

RESPONSE: The language in the ROD is revised to read that wood waste buried in the slag is decomposing, thus contributing to the release of metals, particularly arsenic, from the slag.

19. COMMENT: Page 6, last paragraph, first sentence. The metal levels in groundwater do more than just "appear" to decrease as groundwater moves toward the bay; the data indicate that this decrease is a fact. We suggest changing this sentence to read; "The metal levels in groundwater decrease as groundwater moves through smelter property toward Commencement Bay".

Although the cause of the decrease remains a subject of debate, as pointed out by the description of potential causes in the following sentence, the metals levels decrease is documented by validated data.

RESPONSE: The ROD states that, "The metal levels in groundwater decrease as groundwater moves through the smelter property towards Commencement Bay." EPA agrees that the reason(s) why this decrease occurs has not yet been established.

20. COMMENT: Page 7, first paragraph, last sentence. No large cracks as described in the proposed plan have been identified during the RI/FS. The crack hypothesis is entirely of regulatory origin. Although one well had a higher test permeability than surrounding wells, the significance of the well test relative to groundwater metal transport is not clear. All available evidence indicates that dilution and/or adsorption are occurring to the same degree in the central portion of the site. If anything, dilution and/or adsorption are probably most effective in the central portion of the site, as evidenced by the substantial decrease in metals concentrations over relatively short distances.

RESPONSE: This sentence was not included in the ROD.

21. COMMENT: Page 7, EPA's Cleanup Objectives, first sentence, cleanup actions necessary because of "long-term cancer risks for workers". Long-term cancer risks to sealife and animals were not evaluated as the sentence implies.

RESPONSE: Risks to sealife and animals were qualitatively evaluated in EPA's ecological risk assessment. EPA's conclusion was that sealife has been adversely impacted by releases from the Site and that the Site posed risks to terrestrial animals and vegetation.

22. COMMENT: Page 8, Contaminated Soil Dust and Slag, Objective c, "Prevent the erosion of slag to the off-shore sediments". Existing data suggest the significance of slag erosion is highly overestimated in the Proposed Plan. Although slag contains elevated concentrations of total metals, available data show in the marine environment, slag and sediment that contain slag have a very low leachability. In addition, no detrimental effects of slag on sea life have been documented. In fact, the off-shore community at the smelter is viable and healthy. Slag has been used on the plant site and on the Yacht Club breakwater because its physical properties (coarse grain size and massive texture) made the material an ideal medium for shoreline armoring construction. Armoring of the slag would be primarily cosmetic with little, if any, benefit to the marine environment. While slag armoring could provide a habitat niche for marine life, installation of armoring will, at least temporarily, adversely affect presently established communities.

RESPONSE: EPA believes that slag is eroding to some degree, and therefore exposing faces that leach metals more readily than weathered faces. As part of the remedial design, EPA will require that additional studies are conducted to indicate which part of the slag shoreline is eroding and where shoreline armoring should be placed.

23. COMMENT: Page 11, Shoreline Armoring. This section appears to begin with the premise that shoreline erosion is a substantive issue. Although shoreline armoring was among alternatives evaluated in the FS, to date no information has been produced to document that shoreline erosion is a substantial source of slag to the marine sediments of Commencement Bay.

This question is raised for two reasons. Slag was directly placed in Commencement Bay and its sediments by disposal actions over a 75-year period. Visually obvious erosion could only account for a very small fraction of the slag present in Commencement Bay sediments.

Erosion is visually obvious at some locations along the slag peninsula and smelter property. However, many portions of this area show no obvious evidence of erosion. This raises the question of whether rumoring the total shoreline is appropriate, or if armoring is at all appropriate?

It is also reasonable to question whether slag erosion is causing any environmental other than those produced by physical erosion of natural substrates. The study of freshly cut slag by Battelle (Crecelius, 1966) showed that marine larvae settle as rapidly on slag as on basalt rock and concrete. Although this study showed metals are released from freshly cut slag for three to four months, this brief period would produce very minor contributions of metals to Commencement Bay waters or sediments at the visually apparent erosion rates.

The EPA discussion assumes that a 5 foot thick layer of riprap over a 2 foot layer of small rock is necessary, to prevent erosion. Although total armoring for the shoreline was assumed in alternatives presented in the FS, it will be necessary to conduct an engineering analysis of shore processes along the smelter property and slag peninsula to determine what design is most appropriate, as well as if and where protection might be required.

The existing slope along the north portion of the bayward face of the slag peninsula may be too steep to make armoring practical without major shoreline modification. The steep slope at the north end of the Yacht Club breakwater extends to great depths (at least to 200 feet) indicating that major dredging or cut back at this location may be required to establish a foundation for shoreline monitoring.

Combined plant site and breakwater shoreline armoring costs would be $6.2 million dollars based on assumptions presented in the FS and cost projections presented in the Proposed Plan. This expense would be incurred for primarily cosmetic alterations to the shoreline and provide little environmental benefit. In fact, shoreline armoring will have a significant impact on diverse and apparently healthy communities already established in shoreline slag.

RESPONSE: EPA agrees that additional engineering studies are necessary to determine the extent of shoreline armoring that will be needed in areas that are eroding. EPA does not believe that shoreline armoring will be conducted for cosmetic purposes only, but will be placed in those areas which pose a threat to the offshore environment.

24. COMMENT: Page 14, Plant Site Soils, 1c. It should be noted that, in many cases, sampling results will not determine the feasible extent of excavation, but will provide documentation on post-excavation conditions. Excavation in some areas, particularly in the fine ore bins area and the copper refinery areas, will be limited by equipment capabilities, and by limitations association with high water table and high permeability conditions.

RESPONSE: EPA recognizes that some materials in the source areas will not be able to be excavated, see "implementability" in Section 8.0. In addition, Asarco will be required to confirm that all necessary source area excavation, as practicable, has been performed.

25. COMMENT: Page 14, Plant Site Soils, 1d. In addition to demolition materials, some soil contains coarse grained fractions that are greater than 2 inches in size. During pilot scale testing, these sizes were simply screened out and were not treated. If treatment were to be implemented on a large scale, these fractions would either have to be ground to a finer size for incorporation in the treatment process, or dispose with demolition debris. Either action involves an increase of material handling, processing and costs over those associated with the soil fixation process activities demonstrated during the pilot scale tests.

RESPONSE: EPA understands that there may be some additional costs associated with a full-scale treatment project. However, treatment has not been selected in this ROD for this Site.

26. COMMENT: Page 14, Plant Site Soils, 1e. Removal of the car tunnel was not included in the primary remedial action scenarios evaluated during the FS and this action is not included in the Proposed Plan cost estimates. The FS assumed removal of the car tunnel and railroad tunnels as available options and responsibilities of the owners: Tacoma/Ruston, and Burlington Northern railroad, respectively. Since the tunnel is associated with seeps that have poor water quality, it is possible that concrete from the tunnel, if removed, would require disposal as a hazardous waste. It is estimated that removal of the tunnel, including demolition costs, would increase present cost estimates as high as $2.2 million. Filling the tunnel may be more cost effective than demolition and removal. In addition, the car tunnel is part of a unit construction with the rail tunnel which would be impacted by removal of the car tunnel portion of the structure.

RESPONSE: The determination of whether the tunnel is removed or filled in will be made during the design phase of the project. As noted in Section 9.0 of the ROD, the OCF will be designed to allow for a limited amount of additional capacity in the event there is more than the estimated 160,000 cubic yards of soil and more than the estimated 80,000 cubic yards of demolition debris that requires disposal, see Section 9.1.2. EPA notes that Paragraph 4 of the Agreement in Principle states that: "Asarco agrees to fill or remove the existing tunnel..."

27. COMMENT: Page 15, 3a, use of fabric as marker. A marker would not be necessary for most of the plant site to identify the base of an imported soil cap. The presence of slag which has a very dark color and coarse grained texture that would be significantly different in color and texture from fill, and topsoil imported to the site would provide easy identification when the base of the cap was penetrated. In addition, remaining man-made features such as concrete slabs, foundation or pavement would also easily be identified at the base of the cap.

Ruston soils would also easily be identified. These soils will be incorporated under a drainage gravel layer which is, in turn, underlain by a clay layer. These distinctly different soil types would be easily identified and would mark the locations of the base of imported topsoil as well as the top of underlying Ruston residential soils.

RESPONSE: EPA agrees that a visual marker will not be necessary since the clay layer will serve this function as clay will be located above the slag, building pads and foundations and the Ruston/North Tacoma residential soils.

Asarco is incorrect in stating that the clay layer will underlie the residential soils. The residential soils will be used as a sub-base below the clay on the Site cap. Residential soils can be placed in areas of the site not likely to be impacted by groundwater.

28. COMMENT: Page 16, Figure 3 (in Proposed Plan), Hazardous Waste On-Site Containment Facility (OCF). The figure is not correct. The part of the cover that includes a 1 foot layer, which underlies the filter material, would not consist of compacted soil as shown in the figure but, instead, would consist of a drainage layer.

RESPONSE: In the cap, beneath the one foot of drainage material, there will be a fabric liner and two feet of compacted soil above the waste material, see Figure 7-2.

29. Page 18, Surface Water, second paragraph, last sentence. As noted several times in the FS, large scale treatment of surface water to consistently meet low standards with arsenic and metal marine criteria may not be technically feasible. This is particularly true for the relatively large flows (200 gpm or greater) associated with surface water discharge from drainage areas above the plant site.

RESPONSE: EPA will evaluate the need for, and the feasibility of, surface water treatment after the source control activities in the ROD are completed.

30. COMMENT: Page 18, Shore Line Armoring of the plant site and slag peninsula. "One goal for the shoreline would be to restore aquatic habitat that would benefit eelgrass salmon and other marine life. Methods may include shoreline pull back and sloping, development of pocket beaches, mudflats, vegetated shallows, and shoreline irregularity. There is no evidence that shoreline armoring would provide any aquatic habitat more suitable for marine biota than the existing slag surfaces. The armoring might provide less suitable habitat because of the loss of physical irregularities that the slag provides. Rock riprap provides a generally even, flat surface inhabited by fewer species and number of organisms than the highly irregular surfaces of slag.

Neither slag nor shoreline armoring provide a suitable habitat for eelgrass. Shallow water wave energies that require hard substrates (armoring) prevent eelgrass growth. Eelgrass also requires slit to sand-gravel substrates, not hard surfaces. Salmon and other sea life are capable of using the existing slag habitat, and are unlikely to benefit from shoreline armoring.

Development of pocket beaches, mudflats, shoreline pullback, etc., goes far beyond shoreline armoring. These actions would require great modification of the existing conditions and would result in environmental and economic costs far greater than traditional shoreline armoring as presented in the Feasibility Study. Existing features that have present or potential future economic or environmental value such as the off-shore piers may not survive modifications associated with modifications of features as discussed in EPA's plan. The additional economic costs are not factored in the costs presented in the FS or in the Proposed Plan. Preliminary estimates to include features described in the Proposed Plan as part of shoreline armoring indicate costs would be increased $6 million to $9 million above the $6.25 million presented in the, Proposed Plan for plant site and shoreline armoring costs. Since, as noted above, the area is by nature not suited for many of features such as mudflats, eelgrass, and pocket beaches, as well as shoreline cut backs would involve significant alteration to existing conditions. For instance, off-shore features such as breakwaters would probably be necessary to encourage fine-grained environments that maintain features such as mudflats and eelgrass. Presently not possible in the relatively fast moving coarse grained deposition environment typical to not only the Asarco Site but the adjacent gravel beach areas outside the plant site off-shore area. Obviously, implementation of features that require such an alteration of existing conditions would require considerable study as part of preliminary remedial design efforts.

RESPONSE: The riprap itself is not expected to provide a more suitable habitat than the slag; however, the armoring can be designed to have ledges or irregularities that are more supportive of marine biota than the slag. These areas could be constructed with gravel and on a more gentle slope than the slope of the present Site. A habitat conducive to epibenthic species (organisms living on the sea floor) could be created, which would, in turn, be beneficial to salmon.

EPA agrees that low-energy habitats would not likely persist along the Asarco shoreline. However, a moderately active environment, such as a gravelly/sandy area conducive to other types of aquatic species, may be able to be created off the Asarco Site. Although on-site mitigation is a preference, a habitat that is conducive to eelgrass could be created as part of an off-site mitigation effort.

EPA agrees that reducing the effects of the currents on the exposed face of the Asarco Site would require extensive effort, including the use of groins or breakwaters. These costs, which would be weighed against their benefits, are not part of the shoreline armoring costs in the FS, but rather can be part of the mitigation costs since they would benefit the mitigation efforts. These costs could also be weighed against their overall benefit and/or be compared to other mitigation efforts with similar costs.

Shoreline pullback, sloping, and shoreline irregularity are possible at the Site and can be part of the shoreline armoring and/or mitigation efforts. For example, shoreline armoring, which is intended to reduce the erosion of slag, can be accomplished adjacent to an area that is cut back and less shallow, which could be intended as part of a mitigation site. The most appropriate habitats (e.g., those with the greatest chance of persistence) would then be chosen for these various post-remediation environments. The associated costs could be part of the shoreline armoring costs and the mitigation costs.

EPA will consider the existing futures on-site end the planned uses of the site in the remedial design stage so as to ensure compatibility.

EPA acknowledges that much more about the sediments site will be learned from the ongoing and upcoming expanded RI/FS activities, including a better understanding of the amount of erosion at the site and potential disposal and mitigation sites.

31. COMMENT: Page 18, Shoreline armoring of the plant site and slag peninsula. "Further, since armoring would adversely impact intertidal habitat of the shoreline, mitigation and/or restoration measures would be necessary." The admission that adverse impact to intertidal habitat would occur is evidence that the existing habitat has substantial production and ecological value. Mitigation would apparently be required because this production habitat would be degraded by shoreline armoring. Why conduct armoring unless the habitat would be degraded by shoreline armoring. Why conduct armoring unless the habitat is to be improved by this action? If it is improved, why require mitigation; isn't the action mitigation? Off-shore ecological impacts were noted in the FS evaluation as well as in the EPA Proposed Plan. As off-shore studies by Parametrix have shown, the area contains a diverse and productive environment that is essentially the same as other coarse grained bottom areas that are not located near or potentially impacted by existing or past smelter activities.

RESPONSE: EPA disagrees. EPA acknowledges that there is intertidal habitat that currently occupies the slag face at the Site; however, sampling activities on the off-shore sediment site provide evidence of adverse biological effects. The present expanded RI/FS activities at the sediments site will help quantify the harmful effects at the site with respect to the present communities and allow EPA to balance the benefits of armoring compared to the impacts to existing habitat caused by armoring. EPA agrees that replacing one community with a similar community is not a beneficial use of funds; however, if the present off-shore biological community is shown to be impacted, a replacement community and/or mitigation effort may be warranted.

32. COMMENT: Page 18, Item (9), Safety Measures, lining and covering truck beds. Lining and covering truck beds probably would not be necessary for on-site activities. Excavation in areas such as the arsenic kitchen area, the copper refinery area, or the fine ore bins would not require such precautions. However, it is noted transportation across public roads from areas such as the stack hill or the cooling pond may require some of the safety precautions described in the Proposed Plan.

RESPONSE: If trucks are just moving from one location to another on-site, lining truck beds would probably not be necessary. But lining of truck beds, and other safety measures, will be required for transportation of waste off-site.

33. COMMENT: Page 19, Item 10 (b), guidelines to ensure disposal of dredged sediments would not be preventative or hindered by development activities. Although an OCF could be designed to hold shoreline sediment, additional steps, may have not been completely evaluated, would be necessary to ensure compatibility with incorporation into the OCF. Contrary to the sediment handling procedures anticipated with either use on an OCF or treatment, off shore sediments would have to be dewatered, with subsequent disposal and/or treatment of the decant water. If incorporated into a treatment option for "upland" soils, marine sediments themselves would not require treatment as all testing indicates the leaching potential is very low and most samples had leachable metal concentrations less than analytical limits. However, a key issue would be the increase in size of the OCF "foot print" to hold marine sediments and the resulting loss of available land area available for development. Vertical expansion limited by physical constraints, as well as constraints imposed by proposed road development and aesthetics and an increase of the "foot print" would be necessary. In addition to land needed for a larger foot print, more land area will be needed, at least temporarily, for sediment dewatering during construction, which would also complicate remediation and development logistics.

RESPONSE: EPA has decided not to dispose dredged sediments in the OCF. See the response to Comment No. 28 in Section A above.

34. COMMENT: Page 21, Shoreline Armoring: "Shoreline armoring under the Preferred Alternative is protective because it controls the erosion of the slag shoreline into Commencement Bay". It has not been demonstrated that all or most of the slag shoreline is eroding into the bay or that slag erosion is detrimental to the biological production at the smelter shoreline or slag peninsula.

RESPONSE: See the responses to Comment No. 43 in Section A above and Comment No. 22 in this Section.

35. COMMENT: Page 22, Surface Water "EPA believes that it may be appropriate to establish mixing zone when establishing discharge limitations for surface water". Asarco concurs a mixing zone would be appropriate.

RESPONSE: The language on mixing zone is included in the ROD, see Section 9.9. regarding performance standards for surface water. The determination whether a mixing zone is appropriate and, if so, the parameters of the mixing zone will be made during remedial design.

36. COMMENT: Page 22, Mitigation/Restoration. The Proposed Plan states that mitigation and restoration would be necessary to compensate for "impacts to wetlands" during the cleanup. It is not clear which areas of the site EPA considers to be wetlands. During discussions about remediation of the site, some, parties have taken the position that any alternative which contemplates filling the cooling pond would need to comply with mitigation standards under section 404 of the Clean Water Act. However, the cooling pond is not a wetlands within the definition of "waters of the United States." and section 404 requirements do not apply to its modification during remediation. The Asarco pond was part of a waste treatment system and qualifies for the specific exemption for treatment ponds in 33 CFR §328.3 (a)(7). Consequently, to the extent that there may be other regulated wetlands on the site, the specific areas of the

site involved should be specifically identified and should exclude the cooling pond.

RESPONSE: EPA agrees with Asarco's interpretation regulations that the cooling pond is not a wetland. Other areas of the Site, however, may be wetlands. A wetlands assessment will be required on the Site before remedial activities begin. If any wetlands are identified that will be adversely impacted by remedial activities, the appropriate mitigation measures will be required.

37. COMMENT: Page 24, Surface Water, last sentence referring to surface water treatment relative to long-term effectiveness and permanence. The long-term effectiveness of surface water treatment is questionable if large volumes are necessary to treat and discharge standards are extremely low. Volume control would be key to successful implementation. Treatment would be an on-going operation that would require periodic and relatively consistent maintenance. However, if lines are completely replaced and a design cap is implemented as proposed by EPA, surface water treatment should not be necessary to address sources from the plant site. In effect the treatment plant as proposed by EPA would be addressing off-site sources of arsenic and metals.

RESPONSE: EPA agrees that replacing the surface water drainage system should eliminate the need for surface water treatment. After cleanup activities under the ROD are completed, EPA will determine whether surface water discharging into the bay meets the remediation goals (see Section 9.9 of the ROD).

38. COMMENT: Page 24, Shoreline Armoring, Preferred Alternative, large rock and boulder riprap instead of artificial beach nourishment as riprap has a better potential to withstand current and wave action and remain in place compare to using smaller pebbles under the artificial beach nourishment option." Contrary to EPA's position, coastal engineering and design experts often promote beach nourishment over riprap structures. The Army Corps of Engineers and others prefer, in many cases, to use beach nourishment because it can provide better erosion/deposition control, than riprap design (Mark Lorane, Applied Coastal Science Inc., personal communication). This is particularly true where a potential exists for riprap structures to result in changes in wave and current patterns which result in unexpected and/or uncontrolled erosion or deposition in adjacent unmodified areas.

RESPONSE: EPA recognizes that riprap structures should be constructed only when necessary, and erosion from water flowing around the ends of the slope protection (e.g., breakwater) can cause erosion. The slope protection can be constructed in order to minimize this type of erosion. The design characteristics for the Asarco Site, including the hole of beach nourishment versus riprap structures, can be determined during remedial design, when there is a better understanding of the wave action and current energy at the site.

39. COMMENT: Page 25, Shoreline Armoring, "Slag pieces cause adverse impacts to sea life in offshore sediments." Adverse impacts of slag pieces to sea life have not been demonstrated by EPA's own admission.

RESPONSE: EPA disagrees. A report published by Battelle (Crecelius, 1986) concluded that metals released from freshly exposed slag are toxic to marine organisms for up to three to four months. Also, one of the objectives of the expanded sediments RI/FS is to evaluate whether slag pieces deposited in marine sediments are causing adverse impacts in the marine environment.

40. COMMENT: Page 26, Interception Trench Costs. These costs should be rounded to be consistent with other figures presented in this section.

RESPONSE: These numbers were rounded. See Table 8-2 in Section 8.0 of the ROD.

41. COMMENT: Page 27, Surface Water Costs. On Page 24, EPA states use of surface water treatment if necessary for plant site runoff surface water treatment costs are not presented in the Proposed Plan. The FS presented surface water treatment costs for all anticipated run-on to the site at $23,600,000, present value. EPA's proposal would only address treatment after replacement of the present drainage system and implementation of diversions as necessary. Assuming the majority of runoff is diverted, the EPA proposal could require treatment of some undetermined volume. Even modest volumes of water (50 to 100 gpm) requiring arsenic and metal treatment would result in a significant amount of costs not presented in the plan. Asarco's

experience at the East Helena Superfund site, where a treatment plant was installed to address plant water gains of about 50 gpm, shows costs to treat constituents similar to those at the Tacoma site are about $7,000,000, However, if outfall drainage lines are completely replaced and a design cap is implemented as proposed by EPA, surface water treatment should not be necessary to address sources from the plant site. The treatment plant as proposed by EPA in effect would be addressing off-site sources of arsenic and metals.

RESPONSE: The need for, and feasibility of, surface water treatment will be evaluated should source control activities not attain performance standards for surface water.

42. COMMENT: Page 27, Shoreline Armoring Costs. Assuming riprap shoreline armoring costs as presented in the FS, the costs presented in the Proposed Plan are consistent with the FS. However, the costs do not reflect features discussed in the plan including pocket beaches, mudflats, eel grass, cut backs etc. Preliminary cost projections incorporating features as described in the Proposed Plan indicate shoreline armoring costs could increase $6 million to $9 million over the cost presented in the Proposed Plan. Four scenarios were considered:

1. Armoring as presented in the proposed plan.

2. Armoring assuming no encroachment in the bay and cut backs are necessary prior to riprap installation.

3. Shoreline armoring with advancing slopes and groins, and silt/sand fills needed to create vegetated shallows, pocket beaches and shoreline irregularities for aquatic habitat development.

4. Same as Scenario 3 but all cut backs and no advancing features.

While it is assumed for cost estimation purposes that features described in the four scenarios above could be implemented, it is far from certain incorporation of these features is technically feasible. A summary of preliminary cost estimates for the armoring scenarios is presented below:

Proposed Plan Costs #1	Capital	O&M	Present Worth
Plant site and breakwater	5.9 million	$23,000	$6.2 million
Scenario #2	Capital	O&M	Present Worth
Plant site and breaker	$8-6 million	$24,000	$9.0 million
Scenario #3	Capital	O&M	Present Worth
Plant site and breakwater	$11.9 million	$48,000	$12.6 million
Scenario #4	Capital	O&M	Present Worth
Plant site and breakwater	$14.6 million	$48,000	$15.4 million

RESPONSE: The costs associated with mitigation activities will be in addition to the shoreline armoring costs. Mitigation costs can vary significantly, depending on the location of the site, the necessary preparation activities, and size of the site. Because EPA does not yet know the extent to which shoreline armoring will be required, EPA is not estimating the potential cost of mitigation.

43. COMMENT: Page 27, Institutional Controls. The $500,000 under the O & M (annual) column should be moved to the Present Worth column

RESPONSE: This amount has been moved, see Table 8-2 in Section 8.0 of the ROD.

44. COMMENT: Page 27, Plant Site Excavation Costs. The excavation or demolition costs

presented do not include removal or filling of the car tunnel. As explained in the FS, this option was presumed to be the responsibility of the owner. Removal of the tunnel would increase costs an estimated $2.2 million.

RESPONSE: In Paragraph 4 of the Agreement in Principle, Asarco agreed to remove or fill the car tunnel. EPA believes the approach to be used should be decided during remedial design.

45. COMMENT: Page 29, first column - last sentence continuing to the second column. This sentence is not comprehensible and needs revision.

RESPONSE: EPA corrected the error in subsequent editions of the Proposed Plan.

46. COMMENT: Page 30, (1) Statutory Findings, "cost-effectiveness." Asarco does not concur that soil treatment is cost effective compared to other equally protective alternatives such as containment in an OCF. EPA's preferred alternative is almost $30 million higher than that proposed in the Agreement in Principle between Ruston, Tacoma, the Metropolitan Park District and Asarco.

RESPONSE: EPA has determined in the ROD that disposal of soil and debris in an OCF is a cost-effective cleanup action.

APPENDIX B
FIGURES AND TABLES

<IMG SRC 1095122F>
<IMG SRC 1095122G>

TABLE B-1. INFORMATION REPOSITORIES

In Ruston:	Ruston Town Hall 5117 North Winnifred
	Asarco Information Center 5311 North Commercial
In Tacoma:	Tacoma Public Library Main Branch 1102 Tacoma Avenue South, Northwest Room
	McCormich Regional Branch Library 3722 North 26th
	City of Tacoma 747 Market Street, Suite 420
	Tacoma Pierce County Health Department 3633 Pacific Avenue
	Citizens for a Healthy Bay 771 Broadway
	Pacific Lutheran University Library 121st and South Park Avenue
In Olympia:	Washington Department of Ecology 300 Desmond Drive S.E.
In Seattle:	Environmental Protection Agency 1200 Sixth Avenue

TABLE B-2. LIST OF FACT SHEETS AND BROCHURES FOR THE ASARCO TACOMA SMELTER SITE

Date	Topic(s)
9/86	Fact sheet announcing an AOC between EPA and Asarco for an RI/FS, site stabilization, and an announcement of a public meeting.
10/86	Fact sheet announced a public meeting on November 6, 1986, for concerned citizens to hear about the results of the exposure pathways study for the Asarco Smelter.
4/87	Status Report published.
8/87	Status Report published.
3/88	Status Report published.
5/88	Status Report published.
7/88	Superfund update on the Asarco project.
8/88	Status Report published.
12/16/88	Fact sheet announced that EPA was to study arsenic contamination in the Ruston area, evaluate who might be at risk, and decide what actions need to be taken.
4/27/89	Fact sheet provided a status report of the smelter site RI/FS.
5/11/89	Fact sheet announced that EPA received the proposed work plan from Asarco for demolition of the structures and of the smelter stack.
7/14/89	Fact sheet requested Asarco to conduct the investigation to determine the extent of contamination at the smelter.
9/89	Update of all Superfund projects in Tacoma including information on the Asarco Smelter, and EPA's invitation to residents to join a community workgroup.
2/90	Update of all Superfund projects in Tacoma including a status report on the Asarco Smelter.
5/8/90	Fact sheet announced a Notice of Violation issued to Asarco by EPA.
7/16/90	Fact sheet announced the public meeting and comment period for the proposed plan for the initial site cleanup.
8/90	Update of all Superfund projects in Tacoma including a status report on Asarco.
1/14/91	Fact sheet announced the plan for the interim cleanup measures. This was the first ROD for the site.

TABLE B-2. LIST OF FACT SHEETS AND BROCHURES FOR THE ASARCO TACOMA SMELTER SITE (Continued)

Date	Topic(s)
2/13/91	Update of all Superfund projects in Tacoma including the Asarco Smelter cleanup measures. This fact sheet also included information on EPA's Community Workgroup and community interviews which were underway.
5/6/1991	Fact sheet provided an update of all of the Asarco Superfund projects including the status of the smelter investigation.
8/6/91	Update of all Superfund projects in Tacoma including the Asarco Smelter interim measures (demolition) and the overall site investigation which now includes Asarco sediments.
10/91	Brochure describing all of the Superfund activities related to the Asarco Smelter including; the Ruston North Tacoma Study Area, the smelter site investigation and demolition, and marine sediments.
1/9/92	Fact sheet announced the public meeting and comment period on EPA and Asarco's efforts to demolish structures on the site, including the smelter stack.
3/92	Update of all Superfund projects in Tacoma including the status of the smelter demolition, disposal of the debris, collecting surface water on the site, implementing controls to reduce the amount of surface water entering the site, and an overall site investigation.
7/14/92	Fact sheet updated all of the Asarco Superfund projects.
11/92	Update of all Superfund projects in Tacoma including a status report on the Asarco smelter.
1/11/93	Fact sheet updated all of the Asarco Superfund projects.
6/93	Update on all Superfund projects in Tacoma including the smelter demolition and the overall site investigation.
9/22/93	Fact sheet announced the availability of the RI/FS and Risk Assessment reports for the site.
1/24/94	Update on the hazardous waste cleanup project. EPA integrated the smelter facility and the slag peninsula cleanup activities with the cleanup for the off-shore sediments project.
3/94	Brochure (revision of 10/91 version) describing all of the Superfund activities related to the Asarco Smelter including; the Ruston North Tacoma Study Area, the smelter site investigation and demolition, and marine sediments. This brochure continues to be available to members of the community upon request, and is provided as a handout at all of EPA's public forums.

TABLE B-2. LIST OF FACT SHEETS AND BROCHURES FOR THE ASARCO TACOMA SMELTER SITE (Continued)

Date	Topic(s)
4/28/94	Fact sheet described a field test of a soil treatment technology, which was being considered for the Asarco Site.
8/94	Update on the hazardous waste cleanup projects in Tacoma, including the Asarco demolition activities and the smelter cleanup.
8/12/94	Summary of EPA's Proposed Plan, announcement of public comment period and public meetings.
10/5/94	Fact sheet announced EPA's proposal to allow slag to be moved from Thorne Road to the Asarco Smelter site. Public comments were invited from October 6 to November 4, 1994.
11/21/94	Fact sheet announced Asarco was moving the slag from Thorne Road in the Tacoma tideflats to the former Asarco Smelter in Ruston.
12/29/94	Fact sheet announced that all buildings slated for removal have been demolished and hazardous waste is being stored in the Fine Ore Bins building.

TABLE B-3. ARSENIC CONCENTRATIONS FOR SOIL AND CLASS III GROUND WATER IN THE SOURCE AREAS

ARSENIC KITCHEN

Surface Soil (ppm)		Subsurface Soil >1.5 ft (ppm)		Class III GW Slag (µg/L)		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	33,225	Max:	262,500	Max:	N/A	Max:	117	6
Mean:	16,174	Mean:	7,819					
Min:	2,020	Min:	6.6					

COPPER REFINERY

Surface Soil (ppm)		Subsurface Soil >1.5 ft (ppm)		Class III GW Slag (µg/L		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	N/A	Max:	3,250	Max:	0.271	Max:	0.277	6
Mean:	N/A	Mean:	601					
Min:	N/A	Min:	3.3					

STACK HILL

Surface Soil (ppm)		Subsurface Soil >3 in (ppm)		Class III GW Slag (µg/L		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	3,450	Max:	3,025	Max:	N/A	Max:	4.542	6
Mean:	1,389	Mean:	402					
Min:	112	Min:	0.18					

TABLE B-3. ARSENIC CONCENTRATIONS FOR SOIL AND CLASS III GROUND WATER IN THE SOURCE AREAS (Continued)

FINE ORE BIN BUILDING

Surface Soil (ppm)		Subsurface Soil >7 ft (ppm)		Class III GW Slag (µg/L		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	N/A	Max:	1,180	Max:	31	Max:	2.8	6
Mean:	N/A	Mean:	643					
Min:	N/A	Min:	8					

S.E. Plant area

Surface Soil (ppm)		Subsurface Soil >5 ft (ppm)		Class III GW Slag (µg/L		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	N/A	Max:	24,950	Max:	51.69	Max:	1.5	6
Mean:	N/A	Mean:	4,084					
Min:	N/A	Min:	10					

TABLE B-4. COPPER CONCENTRATIONS FOR SOIL AND CLASS III GROUND WATER IN THE SOURCE AREAS

ARSENIC KITCHEN

Surface Soil (ppm)		Subsurface Soil >1.5 ft (ppm)		Class III GW Slag (µg/L		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	37,375	Max:	53,250	Max:	N/A	Max:	0.0051	40
Mean:	15,308	Mean:	2,669					
Min:	4,838	Min:	8					

COPPER REFINERY

Surface Soil (ppm)		Subsurface Soil >2.5 ft (ppm)		Class III GW Slag (µg/L		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	N/A	Max:	16,700	Max:	0.914	Max:	2.8	40
Mean:	N/A	Mean:	2,159					
Min:	N/A	Min:	29					

STACK HILL

Surface Soil (ppm)		Subsurface Soil >1.5 ft (ppm)		Class III GW Slag (µg/L		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	2,600	Max:	5,750	Max:	N/A	Max:	33	40
Mean:	2,309	Mean:	439					
Min:	2,068	Min:	2					

COOLING POND

Surface Soil (ppm)		Subsurface Soil >3 in (ppm)		Class III GW Slag (µg/L		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	341,250	Max:	1,250	Max:	N/A	Max:	0.011	40
Mean:	59,423	Mean:	122					
Min:	201	Min:	0					

TABLE B-4. COPPER CONCENTRATIONS FOR SOIL AND CLASS III GROUND WATER IN THE SOURCE AREAS (Continued)

FINE ORE BIN BUILDING

Surface Soil (ppm)		Subsurface Soil >7 ft (ppm)		Class III GW Slag (µg/L		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	N/A	Max:	1,980	Max:	0.14	Max:	10.2	40
Mean:	N/A	Mean:	1,230					
Min:	N/A	Min:	60					

S.E. PLANT AREA

Surface Soil (ppm)		Subsurface Soil > 5 ft (ppm)		Class III GW Slag (µg/L		Class III GW Marine Sands (µg/L)		EPA GW PRG (µg/L)
Max:	N/A	Max:	10,975	Max:	0.122	Max:	0.008	40
Mean:	N/A	Mean:	2,246					
Min:	N/A	Min:	0.8					

TABLE B-5. REASONABLE MAXIMUM EXPOSURE ASSUMPTIONS FOR RESIDENTIAL USE

Exposure Group	Exposure Route	Age Group (years)	Body Weight (kg)	Contact Rate	Frequency (days/years)	Duration (years)
Onsite Residents	inhalation	0-30	70	20 m3/day	350	30
	soil ingestion	0-6	15	200 mg/day	350	6
		6-30	70	100 mg/day	350	24
	slag ingestion	0-61	15	110 mg/day	350	6
		6-301	70	55 mg/day	350	24
		0-60	15	22.5 mg/day	350	6
		6-300	70	22.25 mg/day	350	24
	dermala	0-6	15	3900 mg/day	350	6
		6-30	70	1900 mg/day	263	24
				5000 mg/day	87	24
	leafy vegs.	0-6	15	0.3 mg/day	40	6
		6-30	70	1.4 mg/day	40	24
	root vegs.	0-6	15	1.5 g/day	69	6
		6-30	70	2.5 g/day	69	24
	water	0-30	70	2 L/day	350	30
Offsite Residential	inhalation	0-30	70	20m3/day	350	30
Recreational Visitor	inhalationb	0-30				
	soil ingestion	0-6	15	90 mg/day	208, 52, 12	6
		6-30	70	45 mg.day	208, 52, 12	24
	slag ingestion	0-6	15	90 mg/day	208	6
		6-30	70	45 mg/day	208	24
	dermala	0-6	15	12000 mg/day	208, 52, 12	6
		6-30	70	1900 mg/day	156, 39, 9	24
				5000 mg/day	52, 13, 3	24
	fishc	0-30				

Trespasser	inhalationb	6-30				
	soil ingestion	6-30	70	45 mg/day	24	24
	slag ingestion	6-30	70	45 mg/day	24	24
	dermala	6-30	70	1900 mg/day	18	24
				5000 mg/day	6	24

a Skin area available to contact per day in cm2 is multiplied by a soil/skin adherence factor factor of 1.0 mg/mc2, giving units in mg/day.

b Evaluated qualitatively.

c The fish pathway is evaluated by comparison of ground-water concentrations to ambient water quality criteria.

1 Indoor slag ingestion.

2 Outdoor slag ingestion.

TABLE B-6. SLOPE FACTORS FOR CANCER-CAUSING CHEMICALS

CHEMICAL	EXPOSURE ROUTE	CRITERIA VALUEa	WEIGHT OF EVIDENCE CLASSb	TOXIC ENDPOINT	SOURCE
Arsenic	inhalation	15c	A	lung cancer	IRIS
	Oral	1.75	A	skin cancer	IRIS
Beryllium	Oral	4.3	B2	unspecified tumor locations by injection	IRIS IRIS
Cadmium	inhalation	6.3	B1	lung tumors	IRIS
Chromium VI	inhalation	42	A	lung tumors	IRIS
Lead		B2	B2	renal tumors in rate, no criteria values set	IRIS
Nickel	inhalation	B1	A	lung cancer	IRISd
PAHs⊖	oral	A	B2	stomach tumors	IRIS
PCBs	oral	7.7	B2	liver tumors	IRIS
	Dermal	9	B2	liver tumors	see text
Aniline	Oralf	0.0056	B2	spleen and body cavity tumors in rats	IRIS

IRIS Integrated Risk Information System, U.S. EPA (1993b).

a Units (mg/kg/day)-1

b Classification definitions:
A - Human Carcinogen, sufficient evidence in humans.
B1 - Probable Human Carcinogen, limited human data available.
B2 - Probable Human Carcinogen, sufficient evidence in animals, inadequate or no evidence in humans.
C - Possible Human Carcinogen, limited animal evidence.

c The IRIS inhalation slope factor for arsenic is based on an administered dose from occupational exposure, see text.

d IRIS lists a unit risk factor is µg/m3 equivalent to 0.84 (mg/kg/day)-1 for nickel refinery dust.

e The 7 carcinogenic PAHs are: benzo(a)anthracene, benzo(b)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and ideno(1,2,3-cd)pyrene.

f The exposure route for aniline is through ingestion of seafood exposed to aniline in Commencement Bay.

TABLE B-7. REFERENCE DOSES FOR NON-CANCER CAUSING CHEMICALS

CHEMICAL	EXPOSURE ROUTE	RFD/RFCa	UNCERTAINTY FACTOR	RFD/RFC CONFIDENCE	TOXIC ENDPOINT	SOURCE
Antimony	Oral	0.0004	1000	Low	reduced lifespan, altered cholesterol levels	IRIS
Arsenic	Oral	0.0003-0.0008	3	Medium	hyperpigmentation, hyperkeratosis of skin	Glass & SAIC (1992)
						IRIS
Beryllium	Oral	0.005	100	Low	no adverse effects at this dose	IRIS
Cadmium	Oral	0.0005 (water)	10	High	proteins present in urine	IRIS
		0.001 (food)	10	High		
	Dermal	0.000025		Low	proteins present in urine	see text
Chromium Vi	Oral	0.005	500	Low	no adverse effects at this dose	IRIS
Copper	Oral	0.04			gastrointestinal irritation, flu-like disease	HEAST
Leadd	Oral	500 mg/day			neurological and behavioral effect	U.S. EPA (1990e)
Manganese	Oral	0.005 (water)	1	Medium/low	central nervous system effects	IRIS
		0.14 (food)	1	Medium	central nervous system effects	IRIS
Mercury	Oral	0.0003	1000		kidney effects	HEAST
	Inhalation	0.0003	30		neurological	HEAST
Nickel	Oral	0.02	300	Medium	neonatal mortality, dermatological effects	IRIS
Selenium	Oral	0.005	3	High	selenium poisoning, biochemical alterations	IRIS
Silver	Oral	0.005	3	Low	skin discoloration	IRIS
Thallium	Oral	0.00007	3000		hair loss, possible liver effects	HEAST
Zinc	Oral	0.2	10		ANEMIA	HEAST

IRIS Integrated Risk Information System, U.S. EPA (1993b).
HEAST Health Effects Assessment Summary Tables, U.S. EPA (1992d).
RfC Reference Concentration.
RfD Reference Dose.
a Unites of Oral RfD are mg/kg/day; Units of Inhalation are mg/m3, unless noted.
b Results of the uptake/biokinetic model (Glass and SAIC, 1992) is used to assess lead in soil for the residential scenario.

TABLE B-8. ARARs ANALYSIS

The following requirements are applicable or relevant and appropriate requirements (ARARs) for the cleanup of the Asarco Smelter.

ARARs	Summary	Comment
FEDERAL ARARs		
RCRA		
40 U.S.C. § 6901 et seq.		RCRA § 3001(b) (a) (A) (11) and 56 FR 27300 exempt primary copper smelter slag from RCRA. Therefore, RCRA 18 not an ARAR for slag. Other wastes on-site may be characteristic hazardous waste in which case RCRA regulations are potential ARARs. There are no known listed wastes on-site.
40 CFR Part 261		
Identification and Listing of Hazardous Waste	Standards applicable in identifying solid wastes involved in site remediations that are subject to regulation as hazardous wastes.	
40 CFR Part 262		
Standards applicable to Generator. of Hazardous Waste	These packaging and administrative requirements apply if hazardous waste is shipped off-site.	Pursuant to EPA's AOC policy, these requirements do not apply to on-site movement of hazardous waste. (55 Federal Register 8756, March 8, 1990).
40 CFR Part 264		
Standards for Owners and Operator. of Hazardous Waste Treatment, Storage, and Disposal Facilities		The substantive standards detailed below are ARARs for the smelter site remediation if on-site treatment, disposal, or storage of hazardous remediation waste takes place.
40 CFR § 264.18(b)		
Location standard for floodplain	Standards require that washouts from a 100-year flood be prevented.	These requirements apply only to areas on-site deemed within a 100-year floodplain.
Subpad F: Release From Solid Waste Management Units		The requirements of Subpart F are applicable to construction and operation of an OCF.

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
40 CFR § 264.91		
Required programs	Substantive monitoring and response requirements may be applicable if hazardous constituents are detected at points of compliance.	
40 CFR § 264.92		
Groundwater protection standard	Standard requires that the hazardous constituent limits are not exceeded beyond the point of compliance in the uppermost aquifer underlying the waste management area.	
40 CFR § 284.93		
Hazardous constituents	Standards by which EPA identifies the hazardous constituents to which the above groundwater protection standard applies.	
40 CFR § 264.94		
Concentration limits	Concentration limits are set forth for the hazardous constituents identified under 40 CFR § 264.93.	
40 CFR § 264.95 - § 284.99		
Monitoring requirements	Monitoring requirements are set forth to ensure compliance and detect contamination.	
Subpart G: Closure and Post-closure		Subpart G ARARs are applicable to an OCF.
49 CFR § 264.111		
Closure performance standard	A TSD facility must be closed in a manner which minimizes the need for further maintenance and protects human health and the environment.	
4.0 CFR § 264.114		
Disposal or decontamination of equipment, structures and soils	All contaminated soils, equipment and structures must be properly disposed of or decontaminated.	

TABLE B-8. ARAR8 ANALYSIS (Continued)

ARARs	Summary	Comment
40 CFR § 264.117		
Post-closure care and use of property	Monitoring is required alter closure is completed.	
Subpart L: Waste Piles		
40 CFR § 264.251		
Design and operating requirements	Requirements include protection from precipitation and surface water run on, control of dispersal of waste by wind, and no generation of leachate.	
Subpart N: Landfills		The requirements of Subpad N are applicable to construction of an OCF.
40 CFR § 264.301		
Design and operating requirements	Landfill standards require liners and leachate collection systems constructed of materials which provide sufficient protectiveness of human health and the environment.	
40 CFR § 264.303		
Monitoring and inspection	Monitoring of liner integrity required.	
40 CFR § 264.310		
Closure and post-closure care	Closure of a landfill requires a cover which minimizes migration of liquids, functions with minimum maintenance, and provides long-term Integrity.	Monitoring and maintenance is required during the post-closure period identified by EPA.
40 CFR § 268		
Land Disposal Restrictions		
40 CFR § 268.35		
Waste specific prohibitions third-third wastes	Contaminated soil and debris that are hazardous wastes under RCRA are prohibited from off-site land disposal unless treated pursuant to treatment standards.	Under the EPA AOC policy, Land Disposal Restrictions (LDRa) are not applicable to disposal of remediation wastee within an area of contamination. If contaminated soil and debris are disposed of off-site, LDRs are applicable requirements.

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
40 CFR Part 268, Subpart D		
Treatment Standards	Contaminated soil and debris shipped off-site for disposal at a RCRA landfill must be treated before disposal.	If soil and debris are shipped off-site to s RCRA TSD facility and LDR treatment standards apply, a treatability variance may be necessary.
40 CFR § 257.3		
Criteria for classification of solid waste disposal facilities and practices.	A solid waste facility which disposes of non-hazardous waste must meet the following criteria or it will be considered an open dump and be prohibited under RCRA § 4004. A facility located In a floodplain must not wash out in the event of a flood. A facility must not jeopardize endangered species, violate ground water or surface water quality standards or violate air quality standards.	These requirements apply if non-hazardous wastes are disposed of on-site.
40.CFR Part 257, Appendix I	The appendix sets forth MCLs for both organic and inorganic chemicals for use in determining compliance with the ground-water criteria.	
CLEAN WATER ACT		
33 U.S.C. §§ 1251 st.seq.		
CWA §§ 303 and 304 (Federal Water Quality Criteria)	Pursuant to CERCLA § 121(d)(2)(B)(i), otherwise non-enforceable water quality criteria, developed by EPA for surface water, are ARARs. Two kinds of water quality criteria have been developed: one for protection of human health, and another for protection of aquatic life.	
33 U.S.C. § 404 and 40 CFR Part 230		
Discharge of Dredged or fill material	Mitigation measures required for potential adverse impacts to intertidal habitat or wetlands.	
40 CFR § 122.26		
Storm water discharges	NPDES permit standards may apply if it is determined that stormwater discharge contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the U.S.	

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
4O CFR Part 125 - Subpart A		
Criteria and Standards for Imposing Technology-based Treatment Requirements Under Sections 309(B) and 402 of the Act	Standards of control for direct dischargers must meet technology-based requirements. Beat conventional pollution control technology (BCT) is applicable to conventional pollutants. Best available technology economically achievable (BAT) applies to toxic and non-conventional pollutants.	For CERCLA altos, BCT/BAT requirements are determined on a case-by-case basis using best professional Judgment (BPJ).
40 CFR Part 126 - Subpart K	Best management practices (BMPs) must be observed when undertaking Industrial activities which may result in significant amounts of pollutants reaching surface waters.	BMPs are applicable to control the release of hazardous pollutants Into surface waters during the smelter cleanup.
40 CFR Part 126 - Subpart M		
Ocean Discharge Criteria	Discharges to marine waters are permitted as long as the discharge will not cause unreasonable degradation of the marine environment.	NPDES permit is not required if the discharge is within the site boundaries, however, substantive requirements that would otherwise be required under a permit are ARARs. A monitoring program may be required to essess impact of a discharge. Such a requirement is "relevant and appropriate".
40 CFR Part 6, App. A		
Statement of Procedures on Floodplain Management and Wetlands Protection	Requires federal agencies to conduct its activities to avoid, if possible, adverse impacts associated with the destruction or modification of wetlands and occupation or modification of floodplains.	
WASHINGTON INDIAN (PUYALLUP) LAND CLAIMS SETTLEMENT		
25 U.S.C. § 1773	Requires protection of fisheries through control of discharges to Commencement Bay. Compliance with the Settlement Act generally is attained through compliance with ARARs under federal or state law on discharges to surface water.	

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
RIVERS AND HARBORS ACT OF 1899		
33 U.S.C. § § 401 et seq.		
33 U.S.C. § 403		
Obstruction of navigable waters generally; wharves; piers, etc.; excavation and filling in.	Controls the alteration of the navigable waters (i.e., waters subject to ebb and flow of the tide shoreward to the mean high water mark). Activities controlled include construction of structures such as piers, berms, and installation of pilings.	Some minor activities may occur on-site along the shoreline during remediation. No permit is required for on-site activities.
SAFE DRINKING WATER ACT		
42 U.S.C. § § 300(f) et seq.		
40 CFR Part § 41 - Subpart B		
Maximum Contaminant Levels	Maximum contaminant levels (MCLs) are enforceable drinking water standards which are protective of human health. The standards take into account available treatment technology and cost.	
40 CFR Part 141 - Subpart F		
Maximum Contaminant Level Goals	Maximum contaminant level goals (MCLGs) are enforceable health-based goals for drinking water quality and are non-enforceable. CERCLA § 121 (d)(2) outlines use of MCLGs in remedial actions (see also 55 FR 8750.53).	
CLEAN AIR ACT		
42 U.S.C. § 7401 et seq.		
40 CFR Part 50		
National Primary and Secondary Ambient Air Quality Standards	These regulations set forth the National Primary and Secondary Ambient Air Quality Standards (NAAQS) which were developed to protect the public health (allowing an adequate margin of safety).	Some on-site remedial activities, such as handling contaminated soil and using an air stripper may be minor sources of air emmissions.

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
ENDANGERED SPECIES ACT		
16 U.S.C. §§ 1531 et seq.	Federal agencies must ensure that actions they authorize, fund, or carry out are not likely to adversely modify or destroy critical habitat of endangered or threatened species.	
MARINE MAMMAL PROTECTION ACT		
16 U.S.C. §§ 1361 et seq.	EPA must ensure that its actions do not involve the unauthorized taking of marine mammals.	
HAZARDOUS MATERIALS TRANSPORTATION ACT		
49 U.S.C. Ap. §§ 1801 et seq.		
49 CFR Parts 171-177		
U.S. Dept. of Transportation-Subchapter C. Hazardous Materials Regulations	Regulations provide for packaging, documentation, and transport of hazardous waste.	These regulations are requirements for any hazardous waste shipped off-site for disposal during remediation.
NATIONAL HISTORIC PRESERVATION ACT		
16 U.S.C. §§ 470 et seq,	This statute requires EPA to consider effects of remedial actions on historic properties. (This evaluation was conducted in connection with demolition activities.)	The administrative procedural requirements, such as the Cultural Resources Plan, are not ARARs.
ARCHAEOLOGICAL AND HISTORICAL PRESERVATION ACT.		
16 U.S.C. §§ 4699-1	In the event that significant scientific, prehistorical, or archaeological data is present on a site, EPA must approve the remedial activities so that such data is preserved.	
STATE ARARS		The following state statutes and regulations are ARARs only if they result in more stringent standards than those required under federal statutes end regulations. (Requirements under federal programs that

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
MODEL TOXICS CONTROL ACT		
Chapter 70.105D RCW		
WAC 173-340-360		
Selection of cleanup actions	Requires that cleanup actions, to the extent practicable, comply with cleanup standards, use permanent solutions, provide for reasonable time frames, minimize amount of untreated hazardous substances, restore ground water, and utilize long-term monitoring and institutional controls if on-site disposal occurs.	Administrative requirements in this section regarding a cleanup action plan and public participation are not ARARs.
WAC 173-340-440		
Institutional controls	These measures are undertaken to limit or prohibit activities that may interfere with the integrity of a containment area or some other cleanup action.	
WAC 173-340-705		
Use of Method B	Method B cleanup levels are potentially applicable to all sites. Standards must be at least as stringent as applicable state and federal law and they must not result in adverse impact of aquatic and terrestrial life. For hazardous substances for which sufficiently protective standards have not been established, standards can be established by estimations which result in no acute or chronic toxic effects using s hazard quotient of (1); or for carcinogens, concentrations with upper bound excess cancer risk of 1 X 10-6.	At this Site, Method B Is applicable in setting cleanup levels.
WAC 173-340.706		
Use of Method C	Method C cleanup levels may be established at concentrations equal to background or at concentrations which minimize overall threats if attainment of A or B levels will increase the threat to human health and the environment. These levels must be estimated by using a hazard quotient of (1) and a 1 X 10-5 cancer risk for carcinogens.	

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WAC 173.340.707		
Analytical considerations	When the cleanup level is below the practical quantitation limit (PQL), the PQL will become the standard as long as it is not greater than 10X the method detection limit.	
WAC 173.340.708		
Human health risk assessment procedures	This section sets forth the risk assessment framework utilized to establish cleanup standards.	Methodologies for determining background concentrations are potential ARARs.
WAC 173.340-720		
Ground water cleanup standards.	This section sets forth guidelines for ground water cleanup levels, points of compliance, and the ground water classification system. Ground water cleanup levels are based upon the highest beneficial use (i.e. drinking water) unless the ground water is not a potential source due to high concentrations of dissolved solids or insufficient yield. Further, if there is an extremely low probability that the ground water will be a future source of drinking water, the cleanup levels may be based on protection of nearby surface water.	
WAC 173-340-730		
Surface water cleanup standards	Method A cleanup levels are based on the state and federal water quality criteria. Method B cleanup levela require compliance with these criteria unless it can be shown that they are not relevant to the specific water body. Also cleanup levels that are estimated must result in no acute or chronic effects on fish or shellfish and a cancer risk less than or equal to 1 x 10-6. Less stringent Method C levels may be used if consistent with applicable laws, all practicable methods of treatment are utilized, and Institutional controls are implemented. This section also sets forth points of compliance and requires compliance monitoring.	At this Site, Method B is applicable to discharges to surface water.

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WAC 173-340-740		
Soil cleanup standards	This section sets forth residential cleanup levels. For sites undergoing routine cleanup, Table 2, in this section, sets forth applicable standards. Method B allows cleanup standards not already established, to be calculated using concentrations that will not result in toxic effects, contamination of ground water, or a cancer risk that is no greater than 1 X 10-8.	
WAC 173-340-745		
Soil cleanup standards for Industrial sites	Industrial cleanup levels are less stringent than those set for residential areas. To be classified as an industrial site, the following criteria must be satisfied: the site is zoned Industrial use; site was historically used for industrial purposes; adjacent property is currently used or designated Industrial; the site will be zoned industrial for the foreseeable future; and the cleanup action provides for institutional controls. An amendment to state law provides that industrial properties include properties that are or have been characterized by or committed to traditional industrial uses.	
WAC 173-340-750		
Cleanup standards to protect air quality	Removal and containment measures which release hazardous substances to the air must be conducted in accordance with air standards. Residential standards are most stringent. Industrial standards may be established on a case-by-case baals as long as concentrations result in no toxic effects and cancer risk is no greater than 1 X 10-5.	
WATER POLLUTION CONTROL		
WAC 173-201-035		
General considerations	Guidelines are set forth which apply to water quality criteria and classifications such as the antidegradation policy and criteria for short-term modification of water quality standards.	

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WAC 173-201-045		
General water use and criteria classes	This section sets forth water quality criteria for each type of water classification. Criteria considered includes fecal coliform, dissolved oxygen, dissolved gas, temperature, pH, turbidity, toxics, and aesthetics.	
WAC 173-201-047		
Toxic substances	Water quality standards (fresh and marine water) are set forth for several substances deemed toxic. Such substances may not be introduced above natural background if they adversely affect characteristic water uses, public health, or cause acute or chronic conditions.	
WAC 173-216-060		
Prohibited Discharges	Discharges to a municipal sewage system must not interfere with the system's operation.	
WAC 173-220-120		
Prohibited discharges	Prohibits specific discharges into waters of the state such as pollutants that impair anchorage and navigation, and toxic pollutants prohibited under CWA § 307.	
WAC 173-220.130		
Effluent limitations, water quality standards, and other requirements and/or permits	This section sets forth substantive requirements for NPDES permits such as effluent limitations based on known, available, and reasonable methods of treatment. Effluent limitations may be more stringent than those standards developed under the CWA when necessary to meet water quality standards.	
WAC 173-220-210		
Monitoring, recording and reporting	Monitoring is required to ensure that discharges comply with effluent limitations.	Recording and reporting requirements in this section are administrative and, therefore, are not ARARs.
Chapter 173-240 WAC		
Submission of Plans and Reports for Construction of Wastewater Facilities	Construction requirements are set forth for wastewater facilities.	The engineering report and plan requirements in this section are administative and, therefore, are not ARARs.

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
POLLUTION DISCLOSURE ACT OF 1971		
Chapter 90.52 RCW		
RCW 90.52.040		
Wastes to be provided with available methods of treatment prior to discharge into waters of the State.	Regardless of water quality and minimum water quality standards, all wastes must undergo all known, available, and reasonable methods of treatment prior to discharge, except as provided below.	
RCW 90.54.020		
General dedaration of fundamentals for utilization and management of waters of the state.	Regardless of water quality, all discharges to the waters of the state must be provided with all known, available, and reasonable methods of treatment, except where overriding considerations of the public interest will be served.	
CONSTRUCTION PROJECTS IN STATE WATERS		
Chapter 220.110 WAC		
Hydraulic Code Rules	Requirements are set forth for construction projects along waterways, such as bulkhead construction and piling installation, that are designed to protect marine life.	A hydraulic project approval is not required since it is a type of administrative permit.
WELLWATER CONSTRUCTION		
Chapter 18.104 RCW		
WAC 173-160, Part 1		
General requirements	Requirements are set forth which pertain to design and construction of wells generally; such as preservation of natural barriers to prevent water flow between aquifers and permanent sealing.	Permit requirements and other administrative provisions in this section are not ARARs.

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WAC 173-160, Part 3		
Resource protection wells	Specific design and construction requirements are set forth for the drilling and use of monitoring and observation wells.	
UNDERGROUND INJECTION CONTROL PROGRAMS		
Chapter 173-218 WAC	This program requires that injection wells not adversely affect the beneficial use of an underground source of drinking water.	If an injection well is utilized on the smelter site it will be used to inject salt water for treatment purposes and will not adversely affect existing groundwater. These walls would be considered Class V wells that do not inject waste fluids.
HAZARDOUS WASTE MANAGEMENT ACT	This statute provides statutory authority for the Dangerous Waste Regulations (DW) described below.	
Chapter 70.105A RCW		
WAC 173-303-016		
Identifying solid waste.	Guidelines are set forth which identify solid wastes that are also dangerous wastes.	
WAC 173-303.020		
Applicability	Dangerous waste regulations apply to generators, transporters, and owners and operators of TSD facilities.	According to the State's Area of Contamination (AOC) Policy, the movement of DW within an area of contamination is not considered generation. Therefore, the DW regulations are not automatically triggered but may be relevant and appropriate. Similarly, containment, treatment, and disposal of consolidated wastes within an AOC does not automatically trigger the DW regulations. (Interprogram Policy dated September 6, 1991).
WAC 173-303-060		
Notification and Identification numbers	An ID# is required if any dangerous waste is shipped off-site.	Not an ARAR for on-site movement of wastes.
WAC 173-303.070		
Designation of dangerous waste	Procedure for determining whether or not a solid waste is a dangerous waste (DIN) or an extremely hazardous waste (EHW).	

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WAC 173-303-071		
Excluded categories of waste.	Certain categories of waste may be excluded from the requirements of the dangerous waste regulations. For example, under subsection (3)(i), PCB waste whose disposal 18 regulated pursuant to 40 CFR § 761.60 is exempt from most DW regulations.	
WAC 173-303-081		
Discarded chemical products.	A waste is designated a DW if it is a residue from management of chemicals listed on the Discarded Chemical Products List at WAC 173-303-8903.	
WAC 173-303-082		
Dangerous waste sources.	All wastes or residues from wastes listed on the Dangerous Waste Sources List are to be designated either DW or EHW depending on the circumstances.	
WAC 173-303.084		
Dangerous waste mixtures.	A waste mixture that has not been designated a DW must be evaluated to determine whether or not toxic constituents, specific hydrocarbons, or carcinogens are present. If present in sufficient quantities, they are to be treated as DW.	
WAC 173-303-090		
Dangerous waste characteristics	If a waste has characteristics of ignitability, corrosivity, reactivity, or toxicity, it could be designated a DW.	
WAC 173-303-100		
Dangerous waste criteria.	If a person has established that his waste meets the DW criteria, he is a generator and must comply with appropriate DW regulations for generators.	This requirement applies only to those DW which are transported off-site.

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WAC 173-303-101		
Toxic dangerous wastes.	Methods are set forth for determining the toxicity of waste and whether it is a DW or EHW.	
WAC 173-303-102		
Persistent dangerous wastes.	Procedure is set forth to designate wastes that contain halogenated hydrocarbons and/or polycyclic aromatic hydrocarbons with more than three rings and less than seven rings (PAHs) as either DW or EHW.	
WAC 173-303-103		
Carcinogenic dangerous waste.	Method for designating a waste as carcinogenic.	
WAC 173-303-104		
Generic dangerous wastes.	Sets forth the DW number for each of the DW criteria designations.	This requirement is only relevant for wastes shipped off-site for disposal.
WAC 173-303-120		
Recycled, reclaimed, and recovered wastes.	Exempts some recycled DW from the DW regulations if it does not pose a threat to public health and the environment. For example, scrap metal is exempt from DW regulations.	
WAC 173-303-140		
Land disposal restrictions	May require some type of treatment of DW prior to off-site disposal. Treatment of EHW may be required prior to on-site disposal if practicable.	Pursuant to the State's Area of Contamination Policy, the State LDRs are not applicable unless DW is shipped off-site for disposal. Ecology and EPA have agreed to jointly decide the extent of treatment necessary prior to on-site or off-site disposal of EHW.
WAC 173-303-141		
Treatment, storage, or disposal of dangerous waste.	DW shipped off-site for disposal must be shipped to a properly permitted TSD facility.	On-site disposal of DW 18 subject to the state's AOC policy.
WAC 173-303-150		
Division, dilution, and accumulation.	The intent of the DW regulations may not be evaded by dividing or diluting wastes.	

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WAC 173-303-160		
Containers.	Applicable procedure for measuring waste quantity when containers are utilized for shipment of DW off-site.	
WAC 173-303-161		
Overpacked containers (labpacks).	Requirements for overpacked drums such as use of non-leaking inside containers and use of non-reactive material for shipping of DW off-site.	
WAC 173-303-180		
Manifest.	Manifesting is required when DW is generated.	Manifesting required only if DW is transported off-site.
WAC 173.303-270		
Discharge during transport.	Notification requirements apply if a transporter spills DW during transport.	These requirements apply only in the event of a spill during transportation of DW off-site.
WAC 173-303-283		
Performance standards.	A DW facility must be designed and constructed, to the maximum extent practical, to prevent: degradation of ground water quality and air quality, destruction of flora and fauna, excessive noise, negative aesthetic impact, unstable hillsides, and endangerment of employees. Processes used must treat, detoxify, recycle, reclaim, and recover waste material to the extent economically feasible.	
WAC 173-303-550		
Special requirements for facilities managing special waste.	Guidelines by which Ecology will approve less stringent standards for facilities which handle "special wastes".	Special wastes are those that are not considered hazardous waste, under RCRA but are designated a DW under the more stringent state standards.
WAC 173-303-560		
Minimum standards for facilities managing special waste.	Minimum standards are set forth which Ecology may approve for "special waste" facilities.	

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WAC 173-303-600		
Final facility standards.	This section specifies which TSD facilities are subject to closure requirements.	
WAC 173-303-610		
Closure and postclosure.	Closure and performance standards require that a facility be closed to minimize need for further maintenance and control, minimize, or eliminate the escape of DW to the environment. The land must also be returned to the appearance and use of surrounding land to the degree possible. All contaminated soils, equipment, and structure must be disposed of properly. Notice of disposal of waste must be recorded on the deed.	Survey plate, closure plan and certificate requirements in this section are administrative and, thus, are not ARARs. Monitoring to ensure closure integrity is required. Such a requirement is "relevant and appropriate."
WAC 173-303-645		
Releases from solid waste management units.	This section sets forth ground-water monitoring requirements for postclosure periods for facilities that are closed without all DW removed. Criteria is listed by which dangerous constituents are identified and concentration limits are determined. Such requirements are "relevant and appropriate."	
WAC 173-303-660	Requirements for temporary storage of dangerous waste, e.g., protection from precipitation.	
Waste Plies		
WAC 173.303-665		
Landfills.	Landfills must be constructed with a liner and leachate collection system. There must be system to control run-on and run-off. Upon closure, the landfill must be covered with final cover that provides long-term integrity.	
WAC 173-303-9903		
Discarded chemical products list.	Lists of chemicals which are designated as either EHW Or DW.	

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WAC 173-303-9904		
Dangerous waste sources list.	All wastes listed are designated as DW.	
WAC 173-303.9905		
Dangerous waste constituents list.	List of chemically distinct components of a dangerous waste stream or mixture.	
WAC 173-303-9906		
Toxic dangerous waste mixtures graph.	Graph is utilized to determine whether a mixture containing toxics is either a DW or EHW.	
WAC 173-303-9907		
Persistent dangerous waste mixtures graph.	Graph is utilized to determine whether wastes containing certain percentages of persistent DW constituents are DW or EHW.	
Solid Waste Management Reduction and Recycling		
Chapter 70.95 RWC		
WAC 173-304-130		
Location Standards for Disposal Sites.	This section sets forth locational standards regulating proximity of facilities to faults, groundwater, surface water and floodplains.	
WAC 173-304-407		
General closure and post-closure requirements.	Closure performance standards are set forth which require that the need for further maintenance be minimized and threats to human health and the environment be controlled or eliminated.	The closure and post-closure plan requirements and other administrative procedures in this section are not ARARs.

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WAC 173-304-480		
Landfilling standards,	These standard, do not apply to inert wastes and demolition wastes but they do apply to problem wastes. Minimum functional standards require that landfill, not contaminate ground water or surface water. A leachate collection system and liner is required. Also facilities located In floodplains must not restrict the flow of the base flood. Water run-on and run-off must be controlled. Also, dangerous waste disposal is prohibited in a solid waste landfill.	The documentation requirements such as operating plans are administrative and, therefore, are not ARARs.
WAC 173-304-461		
Inert waste and demolition waste landfilling facility requirements.	This section requires that fugitive dust be controlled, that combustible waste be covered to avoid a fire hazard, and that the site be leveled to the extent practicable at closure.	The permitting requirement and other documentation requirements in this section are administrative and, therefore, are not ARARs.
WAC 173-304-490		
Groundwater Monitoring Requirements.	Monitoring is required to ensure that groundwater quality 18 not affected by disposal site.	This requirement Is "relevant end appropriate."
SHORELINE MANAGEMENT ACT OF 1971		
Chapter 90.58 RCW	Local shoreline master programs are set out substantive requirements that apply to construction activities within 200 feet of the shoreline.	Permitting requirements are not ARARs for on-site construction activities.

TABLE B-8. ARARs ANALYSIS (Continued)

ARARs	Summary	Comment
WASHINGTON CLEAN AIR ACT		
Chapter 70.94 ROW		
WAC 173-400-040		
General standards for maximum emissions	All "emission units" (i.e. any activity that emits contaminants to air) are required to use reasonably available control technology. Emissions must not violate opacity standards or cause particulate matter to deposit on adjacent properly which interferes with its enjoyment. Further, reasonable precautions must be taken to prevent fugitive emissions and dust and to reduce odors. No emission is permitted that causes detriment to health, safety, and welfare of any person.	
WAC 173.46O		
Controls For New Sources of Toxic Air Pollutants	An acceptable source impact level is set forth for arsenic. This standard may be an applicable and relevant requirement during the construction phase of the remediation.	
PSAPCA REGULATION 1		
Section 9.15		
Fugitive Dust: Emission Standard	Beat available control technology must be used to control fugitive emissions. Dust emissions are prohibited if they are injurious to human health, plant or animal life or interfere with enjoyment of property.	

APPENDIX C

SUMMARY OF ADDITIONAL SOIL TREATABILITY PILOT-PROJECT FINDINGS

PILOT SCALE TREATABILITY TESTING

OF PLANT SITE SOILS AT THE ASARCO TACOMA SMELTER

ANALYTICAL SUMMARY SUPPLEMENT

Prepared for:

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Plant Site Manager
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Tacoma, WA 98401

Prepared by:

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2727 Airport Rd.
Helena, MT 59601

December 1994

5.O SUMMARY

As outlined in the Pilot Scale Treatability Sampling and Analysis Plan, specific objectives of the pilot scale testing project included:

1. establish an analytical testing program to assess the effectiveness of the treatment in reducing contaminant leachability;

2. optimize additive mix proportions so as to provide lowest cost treatment which meets or exceeds preliminary remediation goals;

3. evaluate sensitivity of treatment effectiveness to variations in feed material quality;

4. refine process operating ranges and monitoring procedures to assure consistent performance during full scale operation.

Extensive chemical and physical tests have been performed to characterize the effectiveness of the treatment method in reducing contaminant leachability. Leach test results on field control lot samples and laboratory compaction samples suggest that the ARCHON solidification/ stabilization process successfully immobilized contaminants, resulting in undetectable or low leachable concentrations of Ag, As, Cd, Cu, Ni, Pb, Sb, Se, TI and Zn. This reduction in leachability was maintained for all treatment mixes, independently of any variations in pre-treatment soil feed or treatment mix percentages.

Physical parameter test results were less conclusive, as physical tests performed on sample molds are apparently not completely representative of actual large scale post-treatment physical properties. Differences in heat generation/retention and associated curing processes are believed to cause observed differences in percent volume change calculations, and may also result in differences between laboratory and field values of permeability and/or compressive strength. Although tests conducted may provide some insight on the physical characteristics of poster soil samples, it should be noted that conditions in the field are likely to be different than those implied by mold test results.

APPENDIX D
ASARCO SMELTER SITE ON-SITE CONTAINMENT FACILITY EVALUATION

<IMG SRC 1095122H>

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

Reply to
Attn of: HW-106 FEB 2 4 1995

MEMORANDUM

SUBJECT: Asarco Smelter Site
On-site Containment
Facility (OCF)

FROM: Catherine Massimino
Senior RCRA/Superfund
Technical Specialist

TO: Piper Peterson
Regional Project Manager
SF Management - II

This is in response to your request for assistance in reviewing the impact of treatment of 15% of the contaminated soils prior to placement in a landfill at the Asarco Smelter Site in Tacoma, Washington.

An evaluation of potential percolation from an on-site containment facility (OCF) located in the central area of the Asarco site as shown on Figure 6-3-6, of Asarco's Smelter Site January 1993, Remedial Investigation Report (RI), was performed. This evaluation bracketed an expected design scenario meeting RCRA landfill standards (hereafter referred to as Scenario A-OCF Good Cap and Liner), and a scenario reflective of long-term deterioration Scenario A of the OCF (hereafter referred to as Scenario B-OCF Poor Cap and No Liner). Both scenarios reflected 25 feet of waste and a landfill surface area of 18 acres. This will accommodate two (2) feet of contaminated soil in addition to the amount that Asarco had approximated on Exhibit A5-3-2 Volume 4-Appendices Asarco Tacoma Plant Feasibility Study (FS) of its conceptual OCF design as necessary to accommodate 240,000 cubic yards of wastes. This additional two (2) feet of waste should allow about a 10% safety factor for waste volume.

This review was performed utilizing the Hydrologic Evaluation of Landfill Performance (HELP) model Version 3.01 The OCF Good Cap and Liner configuration and layers modeled in this review are very similar to the scenario evaluated by Asarco under Appendix 5-2b of Volume 4 of the FS with the following major' exceptions: a) used model synthetically generated precipitation data from Olympia, refined to include monthly precipitation data from Seattle-Tacoma International Airportinstead of 20 years of historic daily precipitation data from Seattle-Tacoma International Airport, a waste layer depth of 25 feet versus 30 feet, a surface area of 18 acres, including OCF liner and cap components versus 10.5 acres, which including only the contaminated soil, SCS runoff curve number was computed by the model, input of leakage fraction for the flexible membrane liner (FML) was replaced by factoring into the model values reflective of good quality for pinhole density, installation defects and overall placement quality, and the model was run for 100 years versus 20. The detailed model inputs and outputs can be found in Attachment 1 to this memorandum.

The major differences in input values for the two scenarios can found on Table 1. The largest difference being the assumption for the Poor Cap and No Liner Scenario B that the bottom liner has so deteriorated that it is no longer functioning as a liner and the percolation being evaluated is from the bottom of the waste. The results of this modeling are summarized in Table 2.

The above HELP modeling results were utilized to estimate contaminate loading from the OCF into Commencement Bay without any pretreatment of the contaminated soils and with 15% of the contaminated soils pretreated. Based on this comparison, which is presented in Table 3, the difference between the arsenic loading from the OCF Scenario B (worst case percolation) of 106 grams per day, when none of the waste is treated versus 15% treated of 90 grams per day, is very minimal. Based on this evaluation, treatment of 15% of the waste can not be justified. As the HELP model is designed to be a comparative evaluation tool this data is not appropriate for use in performing an evaluation of the impact of this loading to Commencement Bay. In addition, it should be noted that this loading comparative determination did not account for dilution or absorption in the soil column of the contaminant during the travel of the percolation out of the OCF to Commencement Bay.

TABLE 1

HELP MODEL MAJOR INPUT VALUE DIFFERENCES BETWEEN SCENARIOS A & B

INPUT VALUES	A. OCF GOOD CAP AND LINER	B. OCF POOR CAP AND NO LINER
Hydraulic conductivity of low permeability soil layer in cap	1 X 10-7 cm/sec	1.2 X 10-6 cm/sec
FML		
Pinhole density	.75 holes/acre	1 hole/acre
Installation defects	2.0 holes/acre	15 holes/acre
Placement Quality	Good	Poor
SCS Runoff Curve #	50.40 based on a good stand of grass	74.40 based on a poor stand of grass
Maximum Leaf Area Index	3.5 based on a good stand of grass	1.0 based on a poor stand of grass
Bottom Liner System	Leachate Collection and Removal System FML Low permeability soil layer Leak Detection Collection and Removal System FML Low permeability soil layer	No functional bottom liner system

TABLE 2
HELP MODELING AVERAGE ANNUAL PERCOLATION RESULTS

OCF SCENARIO	CUBIC FEET/YEAR	CUBIC FEET/DAY
A. OCF GOOD CAP AND LINER	.2	0
B. OCF POOR CAP AND NO LINER	59,176	162

TABLE # 3
ARSENIC CONTAMINATION LOADING TO WATERWAY

LOADING SCENARIO	LOADING TO WATERWAY (GRAMS/DAY)
OCF SCENARIO B 0% TREATMENT ARSENIC 23 PPM (TCLP)1 (UNTREATED)	106
OCF SCENARIO B 15% TREATMENT ARSENIC 23 PPM (TCLP)1 (UNTREATED) ARSENIC > 5.0 PPM (TCLP) (MINIMUM ACCEPTABLE TREATMENT)	93
OCF SCENARIO B 15% TREATMENT ARSENIC 23 PPM (TCLP)1 (UNTREATED) ARSENIC .07 PPM (TCLP)1 (LOWEST TREATMENT LEVEL ACHIEVED)	90

1. Pilot Scale' Treatability Testing of Plant Site Soils at the Asarco Tacoma Smelter, December 1994.

ATTACHMENT 1
OCP HELP MODEL INPUTS AND OUTPUTS

```
           HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
           HELP MODEL VERSION 3.01    (14 OCTOBER 1994)
              DEVELOPED BY ENVIRONMENTAL LABORATORY
                USAE WATERWAYS EXPERIMENT STATION
          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY

PRECIPITATION DATA FILE:        c:\help3\asar1.D4
TEMPERATURE DATA FILE:          c:\help3\ASAR2.D7
SOLAR RADIATION DATA FILE:      c:\help3\ASAR3.D13
EVAPOTRANSPIRATION DATA:        c:\help3\ASAR4.D11
SOIL AND DESIGN DATA FILE:      c:\help3\asar5.D10
OUTPUT DATA FILE:               c:\help3\asar7.OUT

TIME:     9:5        DATE:     2/23/1995


        TITLE:  ASARCO OCF-GOOD CAP AND LINER

        NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
                 COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                                LAYER 1
                                -------

                 TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER    4
        THICKNESS                  =        24.00    INCHES
        POROSITY                   =         0.4370  VOL/VOL
        FIELD CAPACITY             =         0.1050  VOL/VOL
        WILTING POINT              =         0.0470  VOL/VOL
        INITIAL SOIL WATER CONTENT =         0.3896  VOL/VOL
        EFFECTIVE SAT. HYD. COND.  =    0.170000002000E-02 CM/SEC
      NOTE:   SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 4.63
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 1

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4170	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999978000E-02	CM/SEC
SLOPE	=	15.00	PERCENT
DRAINAGE LENGTH	=	600.0	FEET

LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC -
FML PINHOLE DENSITY	=	0.75	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 4

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 16

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 18

THICKNESS	=	300.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2920	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

```
                         LAYER 6
                         -------

              TYPE 2 - LATERAL DRAINAGE LAYER
                  MATERIAL TEXTURE NUMBER 1
THICKNESS                  =      12.00     INCHES
POROSITY                   =       0.4170   VOL/VOL
FIELD CAPACITY             =       0.0450   VOL/VOL
WILTING POINT              =       0.0180   VOL/VOL
INITIAL SOIL WATER CONTENT =       0.0451   VOL/VOL
EFFECTIVE SAT. HYD. COND.  =    0.999999978000E-02 CM/SEC
SLOPE                      =       1.50     PERCENT
DRAINAGE LENGTH            =     600.0      FEET

                         LAYER 7
                         -------

                TYPE 4 - FLEXIBLE MEMBRANE LINER
                   MATERIAL TEXTURE NUMBER 35
THICKNESS                  =       0.06     INCHES
POROSITY                   =       0.0000   VOL/VOL
FIELD CAPACITY             =       0.0000   VOL/VOL
WILTING POINT              =       0.0000   VOL/VOL
INITIAL SOIL WATER CONTENT =       0.0000   VOL/VOL
EFFECTIVE SAT. HYD. COND.  =    0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY        =       0.75     HOLES/ACRE
FML INSTALLATION DEFECTS   =       2.00     HOLES/ACHE
FML PLACEMENT QUALITY      =    3 - GOOD

                         LAYER 8
                         -------

                 TYPE 3 - BARRIER SOIL LINER
                 MATERIAL TEXTURE NUMBER 16
THICKNESS                  =      12.00     INCHES             :
POROSITY                   =       0.4270   VOL/VOL
FIELD CAPACITY             =       0.4180   VOL/VOL
WILTING POINT              =       0.3670   VOL/VOL
INITIAL SOIL WATER CONTENT =       0.4270   VOL/VOL
EFFECTIVE SAT. HYD. COND.  =    0.100000001000E-06 CM/SEC

                         LAYER 9
                         -------

                TYPE 2 - LATERAL DRAINAGE LAYER
                   MATERIAL TEXTURE NUMBER 1
THICKNESS                  =      12.00     INCHES
POROSITY                   =       0.4170   VOL/VOL
FIELD CAPACITY             =       0.0450   VOL/VOL
WILTING POINT              =       0.0180   VOL/VOL
INITIAL SOIL WATER CONTENT =       0.0450   VOL/VOL
EFFECTIVE SAT. HYD. COND.  =    0.999999978000E-02 CH/SEC
SLOPE                      =       1.50     PERCENT
DRAINAGE LENGTH            =     600.0      FEET
```

LAYER 10

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEX NUMBER 35

```
THICKNESS                  =       0.06     INCHES
POROSITY                   =       0.0000   VOL/VOL
FIELD CAPACITY             =       0.0000   VOL/VOL
WILTING POINT              =       0.0000   VOL/VOL
INITIAL SOIL WATER CONTENT =       0.0000   VOL/VOL
EFFECTIVE SAT. HYD. COND.  =   0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY        =       0.75     HOLES/ACRE
FML INSTALLATION DEFECTS   =       2.00     HOLES/ACRE
FML PLACEMENT QUALITY      =   3 - GOOD
```

LAYER 11

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

```
THICKNESS                  =      36.00     INCHES
POROSITY                   =       0.4270   VOL/VOL
FIELD CAPACITY             =       0.4180   VOL/VOL
WILTING POINT              =       0.3670   VOL/VOL
INITIAL SOIL WATER CONTENT =       0.4270   VOL/VOL
EFFECTIVE SAT. HYD. COND.  =   0.100000001000E-06 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A
GOOD STAND OF GRASS, A SURFACE SLOPE OF 15.%
AND A SLOPE LENGTH OF 600. FEET.

```
SCS RUNOFF CURVE NUMBER              =        50.40
FRACTION OF AREA ALLOWING RUNOFF     =       100.0     PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =        18.000   ACRES
EVAPORATIVE ZONE DEPTH               =        24.0     INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =         9.350   INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =        10.488   INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =         1.128   INCHES
INITIAL SNOW WATER                   =         0.000   INCHES
INITIAL WATER IN LAYER MATERIALS     =       133.780   INCHES
TOTAL INITIAL WATER                  =       133.780   INCHES
TOTAL SUBSURFACE INFLOW              =         0.00    INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
SEATTLE WASHINGTON

MAXIMUM LEAF AREA INDEX	=	3.50
START OF GROWING SEASON (JULIAN DATE)	=	126
END OF GROWING SEASON (JULIAN DATE)	=	287
AVERAGE ANNUAL WIND SPEED	=	9.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	79.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OLYMPIA WASHINGTON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
8.50	5.77	4.85	3.13	1.85	1.44
0.76	1.34	2.36	4.68	7.58	8.70

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.10	42.80	44.20	48.70	55.00	60.20
64.80	64.10	60.00	52.50	44.80	41.00

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON

STATION LATITUDE = 47.25 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	8.48	5.55	4.95	3.47	1.83	1.43
	0.73	1.17	2.24	4.85	7.17	8.99
STD. DEVIATIONS	2.48	1.86	1.62	1.29	0.92	0.75
	0.55	0.91	1.28	1.98	2.42	2.67
RUNOFF						
TOTALS	0.471	0.096	0.007	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.007	0.095
STD. DEVIATIONS	1.093	0.512	0.065	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.070	0.368
EVAPOTRANSPIRATION						
TOTALS	0.887	1.166	2.109	2.786	2.124	2.672
	0.803	0.963	1.843	1.378	0.854	0.781
STD. DEVIATIONS	0.130	0.124	0.234	0.561	0.713	0.733
	0.639	0.656	0.896	0.310	0.095	0.101
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	6.6818	5.5886	5.1586	3.3013	1.6522	0.8300
	0.3824	0.1291	0.0756	0.2970	2.4738	5.2597
STD. DEVIATIONS	1.3233	1.0815	0.9991	0.9407	0.5661	0.2387
	0.1023	0.0345	0.0815	0.3890	1.3277	1.3733
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0009	0.0008	0.0006	0.0003	0.0002	0.0001
	0.0000	0.0000	0.0000	0.0000	0.0003	0.0007
STD. DEVIATIONS	0.0003	0.0002	0.0002	0.0001	0.0001	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0002	0.0003
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0003	0.0003	0.0004	0.0004	0.0004	0.0004
	0.0003	0.0003	0.0003	0.0002	0.0002	0.0003
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 8						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 11

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

AVERAGES	23.0939	21.6862	15.6914	8.3893	3.8451	1.9959
	0.8900	0.3004	0.1817	0.6942	6.6162	16.3563
STD. DEVIATIONS	6.7204	6.1436	5.4720	3.2647	1.3175	0.5740
	0.2380	0.0804	0.1960	0.9121	4.3865	6.7256

DAILY AVERAGE HEAD ACROSS LAYER 8

AVERAGES	0.0073	0.0087	0.0096	0.0097	0.0093	0.0086
	0.0078	0.0070	0.0063	0.0056	0.0053	0.0059
STD. DEVIATIONS	0.0014	0.0015	0.0016	0.0016	0.0015	0.0014
	0.0013	0.0011	0.0010	0.0009	0.0009	0.0011

DAILY AVERAGE HEAD ACROSS LAYER 11

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	50.86	(6.475)	3323272.0	100.00
RUNOFF	0.676	(1.5808)	44185.56	1.330
EVAPOTRANSPIRATION	18.367	(1.9076)	1200101.62	36.112
LATERAL DRAINAGE COLLECTED FROM LAYER 2	31.83005	(4.97177)	2079775.620	62.58217
PERCOLATION/LEAKAGE THROUGH FROM LAYER 4	0.00395	(-.00083)	257.638	0.00776
AVERAGE HEAD ACROSS TOP OF LAYER 4	8.312	(1.829)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00392	(0.00062)	255.990	0.00770
PERCOLATION/LEAKAGE THROUGH FROM LAYER 8	0.00001	(0.00000)	0.575	0.00002
AVERAGE HEAD ACROSS TOP OF LAYER 8	0.008	(0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 9	0.00001	(0.00000)	0.409	0.00001
PERCOLATION/LEAKAGE THROUGH FROM LAYER 11	0.00000	(0.00000)	0.164	0.00000
AVERAGE HEAD ACROSS TOP OF LAYER 11	0.000	(0.000)		
CHANGE IN WATER STORAGE	-0.016	(2.8735)	-1048.51	-0.032

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	4.21	275081.406
RUNOFF	2.375	155191.7810
DRAINAGE COLLECTED FROM LAYER 2	0.32559	21273.99410
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000046	2.98295
AVERAGE HEAD ACROSS LAYER 4	36.000	
DRAINAGE COLLECTED FROM LAYER 6	0.00002	1.23588
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00233
AVERAGE HEAD ACROSS LAYER 8	0.013	
DRAINAGE COLLECTED FROM LAYER 9	0.00000	0.00145
PERCOLATION/LEAKAGE THROUGH LAYER 11	0.000000	0.00045
AVERAGE HEAD ACROSS LAYER 11	0.000	
SNOW WATER	5.93	387674.5310
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4370	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0371	

FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	7.7436	0.3226
2	5.0039	0.4170
3	0.0000	0.0000
4	10.2480	0.4270
5	87.6000	0.2920
6	0.5435	0.0453
7	0.0000	0.0000
8	5.1240	0.4270
9	0.5400	0.0450
10	0.0000	0.0000
11	15.3720	0.4270
SNOW WATER	0.000	

```
          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
          HELP MODELVERSION 3.01    (14 OCTOBER 1994)
               DEVELOPED BY ENVIRONMENTAL LABORATORY
                USAE WATERWAYS EXPERIMENT STATION
          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY


PRECIPITATION DATA FILE:        c:\help3\asar1.D4
TEMPERATURE DATA FILE:          c:\help3\ASAR2.D7
SOLAR RADIATION DATA FILE:      c:\help3\ASAR3.D13
EVAPOTRANSPIRATION DATA:        c:\help3\ASAR4.D11
SOIL AND DESIGN DATAFILE:       c:\help3\asar10.D10
OUTPUT DATA FILE:               c:\help3\asar11.OUT

TIME:  12:23     DATE:  2/23/1995



    TITLE:  ASAR-OCF POOR CAP AND NO LINER

    NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
             COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                                   LAYER 1
                                   -------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                       MATERIAL TEXTURE NUMBER 4
        THICKNESS                      =        24.00    INCHES
        POROSITY                       =         0.4370  VOL/VOL
        FIELD CAPACITY                 =         0.1050  VOL/VOL
        WILTING POINT                  =         0.0470  VOL/VOL
        INITIAL SOIL WATER CONTENT     =         0.3946  VOL/VOL
        EFFECTIVE SAT. HYD. COND.      =   0.170000002000E-02 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
               FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER 2
                                   -------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER 1
        THICKNESS                      =        12.00    INCHES
        POROSITY                       =         0.4170  VOL/VOL
        FIELD CAPACITY                 =         0.0450  VOL/VOL
        WILTING POINT                  =         0.0180  VOL/VOL
        INITIAL SOIL WATER CONTENT     =         0.4170  VOL/VOL
        EFFECTIVE SAT. HYD. COND.      =   0.999999978000E-02 CM/SEC
        SLOPE                          =        15.00    PERCENT
        DRAINAGE LENGTH                =       600.0     FEET
```

LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	15.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 4

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 28

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4520	VOL/VOL
FIELD CAPACITY	=	0.4110	VOL/VOL
WILTING POINT	=	0.3110	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4520	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.120000004000E-05	CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 18

THICKNESS	=	300.00	INCHES
POROSITY	=	0.6710	VOL/VOL
FIELD CAPACITY	=	0.2920	VOL/VOL
WILTING POINT	=	0.0770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2585	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A
POOR STAND OF GRASS, A SURFACE SLOPE OF 15.%
AND A SLOPE LENGTH OF 600. FEET.

SCS RUNOFF CURVE NUMBER	=	74.40	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	18.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	9.472	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	10.488	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.128	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	102.873	INCHES
TOTAL INITIAL WATER	=	102.873	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
SEATTLE WASHINGTON

MAXIMUM LEAF AREA INDEX	=	1.00
START OF GROWING SEASON (JULIAN DATE)	=	126
END OF GROWING SEASON (JULIAN DATE)	=	287
AVERAGE ANNUAL WIND SPEED	=	9.10 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	70.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	79.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR OLYMPIA WASHINGTON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
8.50	5.77	4.85	3.13	1.85	1.44
0.76	1.34	2.36	4.68	7.58	8.70

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
39.10	42.80	44.20	48.70	55.00	60.20
64.80	64.10	60.00	52.50	44.80	41.00

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR SEATTLE WASHINGTON

STATION LATITUDE = 47.25 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	8.48	5.55	4.95	3.47	1.83	1.43
	0.73	1.17	2.24	4.85	7.17	8.99
STD. DEVIATIONS	2.48	1.86	1.62	1.29	0.92	0.75
	0.55	0.91	1.28	1.98	2.42	2.67
RUNOFF						
TOTALS	0.759	0.211	0.020	0.000	0.000	0.000
	0.000	0.001	0.000	0.016	0.102	0.268
STD. DEVIATIONS	1.248	0.611	0.074	0.002	0.000	0.000
	0.000	0.007	0.001	0.042	0.245	0.489
EVAPOTRANSPIRATION						
TOTALS	0.905	1.192	2.135	2.799	1.971	1.667
	1.830	0.946	1.840	1.417	0.896	0.804
STD. DEVIATIONS	0.135	0.128	0.239	0.562	0.723	0.655
	0.594	0.625	0.784	0.311	0.093	0.102
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	6.0866	5.2809	5.0379	3.2242	1.5906	0.6625
	0.4098	0.3022	0.1549	0.3263	2.3414	4.9313
STD. DEVIATIONS	0.8787	0.8563	0.9630	0.9714	0.5746	0.2241
	0.1305	0.0716	0.0932	0.3827	1.2727	1.1089
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.1734	0.1474	0.1187	0.0632	0.0312	0.0140
	0.0091	0.0069	0.0038	0.0070	0.0476	0.1189
STD. DEVIATIONS	0.0541	0.0446	0.0434	0.0246	0.0103	0.0043
	0.0026	0.0015	0.0019	0.0074	0.0299	0.0479
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0976	0.0942	0.0939	0.0696	0.0424	0.0366
	0.0589	0.0809	0.0830	0.0849	0.0807	0.0828
STD. DEVIATIONS	0.0579	0.0490	0.0554	0.0556	0.0645	0.0646
	0.0626	0.0486	0.0411	0.0407	0.0376	0.0373

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 4

AVERAGES	22.9199	21.7227	15.5777	8.2423	3.7024	1.5931
	0.9538	0.7033	0.3726	0.7612	6.1819	15.6073
STD. DEVIATIONS	7.4144	6.8048	5.9889	3.4758	1.3393	0.5390
	0.3036	0.1667	0.2241	0.8942	4.1311	6.6014

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	50.86	(6.475)	3323272.0	100.00
RUNOFF	1.377	(1.8037)	89991.96	2.708
EVAPOTRANSPIRATION	18.403	(1.8619)	1202469.50	36.183
LATERAL DRAINAGE COLLECTED FROM LAYER 2	30.34872	(4.43701)	1982985.250	59.66967
PERCOLATION/LEAKAGE THROUGH FROM LAYER 4	0.74124	(0.16771)	45432.398	1.45737
AVERAGE HEAD ACROSS TOP OF LAYER 4	8.195	(1.963)		
PERCOLATION/LEAKAGE THROUGH FROM LAYER 5	0.90567	(0.58497)	59176.180	1.78066
CHANGE IN WATER STORAGE	-0.174	(2.9367)	-11351.36	-0.342

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	4.21	275081.406
RUNOFF	2.396	156543.9220
DRAINAGE COLLECTED FROM LAYER 2	0.24520	16021.60160
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.008608	562.45880
AVERAGE HEAD ACROSS LAYER 4	35.941	
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.021394	1397.89368
SNOW WATER	5.93	387674.5310

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4370
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0406

FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	8.5417	0.3559
2	5.0039	0.4170
3	0.0000	0.0000
4	10.8480	0.4520
5	61.1068	0.2037
SNOW WATER	0.000	

APPENDIX E

STATE DEPARTMENT OF ECOLOGY'S CONCURRENCE LETTER

<IMG SRC 1095122I>

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

P.O. Box 47600 ! Olympia, Washington 95504-7600 ! (206) 407-6000 ! TDD Only (Hearing Impaired) (206) 407-6006

March 22, 1995

Mr. Randy Smith
US EPA Region X
1200 Sixth Avenue
Seattle, WA 98101

Dear Mr. Smith:

Re: Record of Decision for the Asarco Tacoma Smelter Facility

The State of Washington concurs with the selected remedy and phased approach described in this Record of Decision for the Asarco Tacoma Smelter facility. The combination of measures to excavate and consolidate the more highly contaminated soils and debris in a containment facility with design equivalent to federal hazardous waste disposal standards, to cap the entire site, and to provide certain site restrictions is appropriate and protective against exposure to such soils.

The current ROD provides for measures to divert surface waters from contact with contaminants, however, the ROD provides for additional remedial measures to be taken on surface water, should such further measure be necessary. The current ROD is an interim action for ground water. Final ground water remediation will be addressed in a separate, second-phase ROD that will be prepared after the impacts of the soils actions and water diversion measures have been evaluated. This approach and the selected remedy are deemed to be in compliance with the environmental laws and regulations of the state.

If you have any questions, please contact Bruce Cochran at (360)407-7227.

Sincerely,

<IMG SRC 1095122J>

Mary E. Burg, Program Manager
Toxics Cleanup Program

MEB:gj

cc: Bruce Cochran, Ecology

APPENDIX F
ADMINISTRATIVE RECORD INDEX

Due to its large size,
the administrative record index is not included
but may be obtained from the Region.